SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVII AUGUST, 1913 NUMBER 2

LATERAL CURVATURE[1]

BY EDVILLE GERHARDT ABBOTT, A. M., M. D., PORTLAND, MAINE

GENERALLY speaking, deformities may be divided into two groups; first, those in which there is a focus of disease in some of the structures entering into the distortion; second, those in which the parts are simply twisted or displaced.

The methods of treatment in each of these two groups differ so widely one from the other that the mistake of substituting what would be efficient in the former for that of the latter, or vice versa, would result in an increase of the deformity or perhaps fatally.

For example, in tuberculosis of the cervical spine the accepted treatment is long fixation in as favorable position as can be maintained; every effort is directed toward preventing motion. In wry-neck, a deformity involving the same structures, treatment is applied for the purpose of establishing normal motion.

It is one of the deformities of the second group that we have under consideration, i.e., a deformity in which there is no focus of disease in any of the anatomical parts entering into it; one in which the structures are simply twisted, displaced, and distorted, namely, that of scoliosis or lateral curvature of the spine.

There are two fundamental principles governing the treatment of this class or group of deformities which must be applied if one is to expect good results; first, the deformity must be over-corrected; second, it must be held in the over-corrected position until the distorted parts — muscles, bones, and ligaments — have changed from the pathological to the normal.

Let us consider these principles briefly in order to understand why it is necessary to apply them.

From an orthopedic point of view, the individual must possess the ability to place the different parts of the body in any of the various positions which the normal person is capable of doing. Any restriction of these normal limits of motion causes deformity.

There are parts of the body in which loss of these normal limits of motion is followed by a deformity that is not only disabling, but unsightly; for instance, if the motion of abduction and flexion in the foot is lost a club-foot develops.

The spine in many ways is not unlike the foot in its movements, and if for any reason the normal limits of motion are restricted, distortion follows. The normal spine is capable of assuming postures opposite in direction with equal ease, and any condition which prevents this flexible body from bending just as far to one side as to the other crooks it.

In the erect position the normal spine is straight when viewed antero-posteriorly, but it bends with equal ease just as far to the

[1] Read before the Third Clinical Congress of Surgeons of North America, New York City, November 15, 1912.

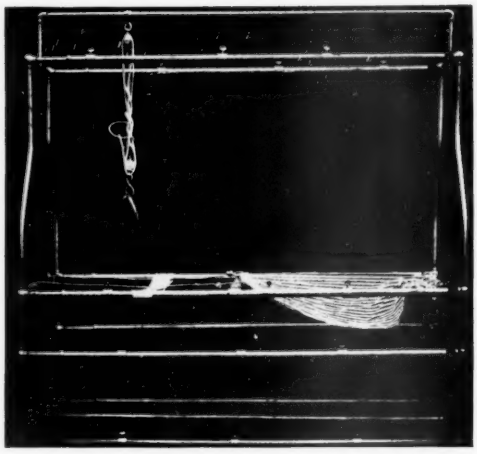


Fig. 1. Brackett frame with superstructure added.

right as to the left and if for any reason motion either to the right or left is restricted it soon habitually assumes a position midway between the erect and that of the limit of motion to one side. In other words, a lateral curve develops.

It is apparent, then, that in such parts of the body as the foot and spine, unless these normal limits of motion are present, deformity will develop.

It is also perfectly obvious that in the correction of such deformities as club-foot and scoliosis the same laws which govern their development control their reduction.

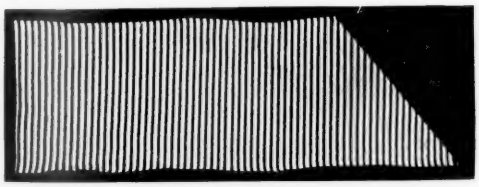


Fig. 2. Hammock cut diagonally across one end.

Referring again to the foot for an example: if a club-foot be operated upon and be brought to the correct anatomical position, i.e., a position of flexion to right angle with the leg and to a point midway between abduction and adduction, the operation is a failure. On the other hand, if after operating the surgeon place the foot in the position of extreme flexion and abduction, i.e., in a position exactly opposite to the original deformity, the operation should be successful. In other words, the club-foot must be first over-corrected.

A successful final result depends, however, on something more than the operation plus an over-corrected position. The foot must not only be placed in this over-corrected position, but it must be held and used there

Fig. 3. Patient placed on frame in position of flexion.

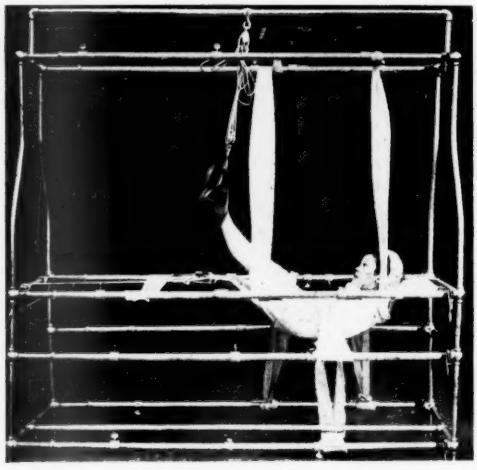


Fig. 4. Showing traction straps attached to windlasses.

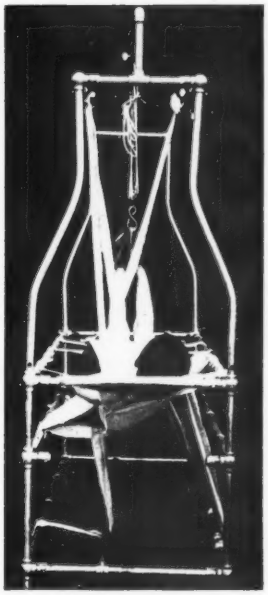


Fig. 5. Showing traction straps attached to windlasses.

until the parts have changed from the pathological to the normal.

So in lateral curvature of the spine, or scoliosis, the deformity must first be overcorrected and then held in this position for a considerable period until the structures have regained their normal shape and functions.

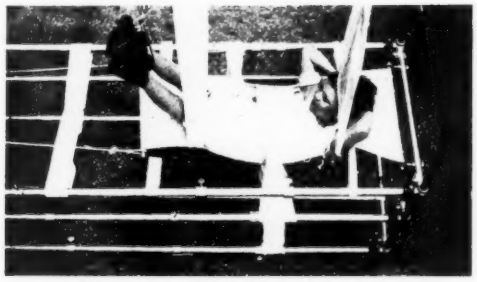


Fig. 6. Showing traction straps attached to windlass.

The deformity of lateral curvature in its first stages is an easily defined position. It is a normal physiological position, one which may be and is assumed by the individual frequently during the ordinary activities of every day life. It is the position of flexion, plus lateral bending, plus rotation of the bodies of the vertebræ toward the convexity of the lateral curve. In this position one shoulder is elevated, the other depressed, and the pelvis may be tilted on its vertical axis. The posture is frequently assumed when a person becomes over-tired, or when performing some kinds of labor, and is commonly found in school children sitting in a faulty position at a desk.

The position having been found in which a lateral curvature develops, or in which it may be created,[1] it is obvious, if the foregoing con-

[1] N. Y. M. J., 1911, June 24.

Fig. 7. Showing window cut over formerly depressed ribs.

Fig. 8. Windows cut for the insertion of felt to make lateral pressure.

Fig. 9. Window cut for the insertion of felt to remove rotation.

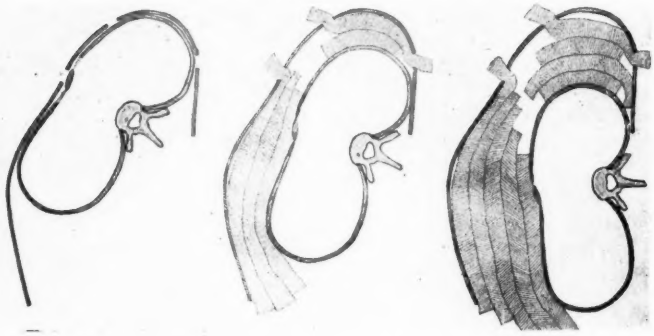


Fig. 10. Diagrammatic illustration showing how felt is inserted through window.

clusions are correct, that the patient should be placed in a posture opposite to that in which the deformity developed, and held there, not only until all restrictions to normal motion have been removed, but until the necessary changes have taken place in the structures to insure a cure.

The easiest method for obtaining this position,[1] i.e., that of over-correction, is, perhaps, by placing the patient on a specially constructed frame made for this purpose. The apparatus is similar to the so-called Brackett frame used in applying plaster corsets in Pott's disease, with an added superstructure (Fig. 1). It is made of gas-pipe in the usual dimension: length five and one-half feet; width, twenty-six inches; height, seven feet. On either side are four windlasses for making traction and at the top a bar extends lengthwise so that the feet may be elevated. At the bottom there is a movable bar so that the traction for removing the rotation may be correctly adjusted. The patient is placed face up on a hammock (Fig. 2) suspended from the frame (Fig. 3) in the position of flexion; straps are applied (Figs. 4, 5, 6) and the corset is so shaped as to allow of further correction, and a plaster dressing applied. As soon as the dressing becomes fixed the patient is removed from the frame

[1] In the finding of the correct position for the patient when the corset is applied it is best to have a skiagram of the spine so that the necessary pulls may be applied at exactly the right points.

Fig. 11. Patient before hips and shoulders are set over.

Fig. 12. Corset cut out under shoulder and over hip.

Fig. 13. Shoulder and hip set over and hip again closed in by plaster.

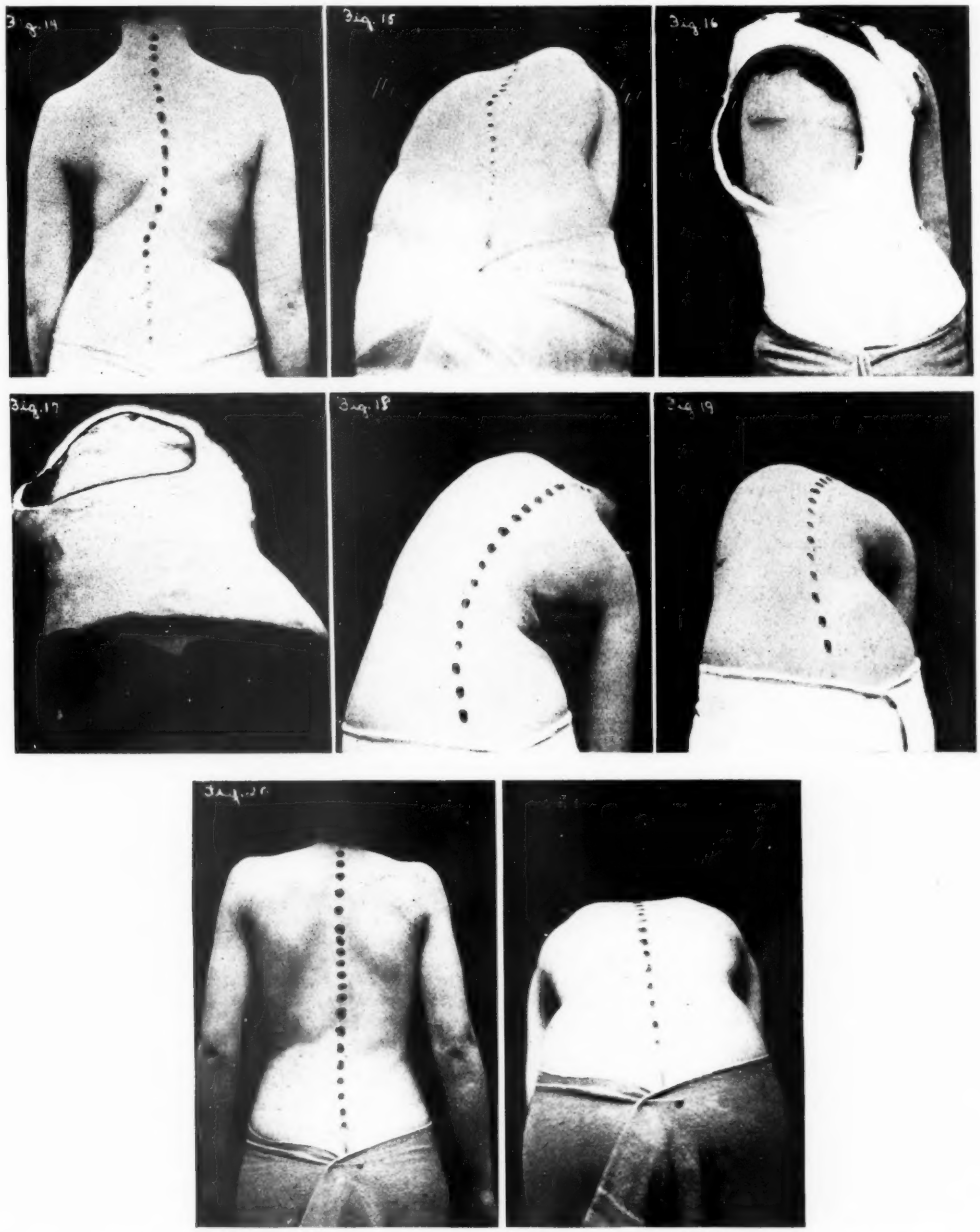


Fig. 14. Standing before.
Fig. 15. Bending before.
Fig. 16. Over-corrected in plaster, standing.
Fig. 17. Over-corrected in plaster, bending.
Fig. 18. Over-corrected plaster removed, standing.
Fig. 19. Over-corrected plaster removed, bending.
Fig. 20. After three months' exercise, standing.
Fig. 21. After three months' exercise, bending.

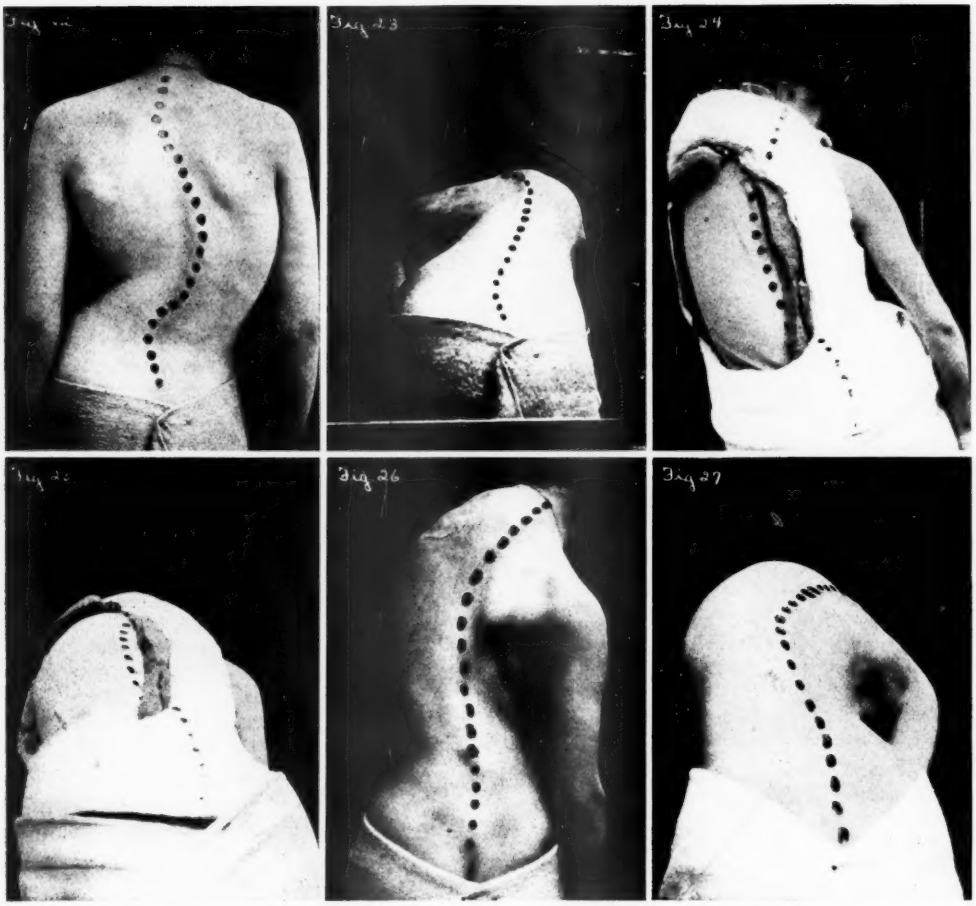
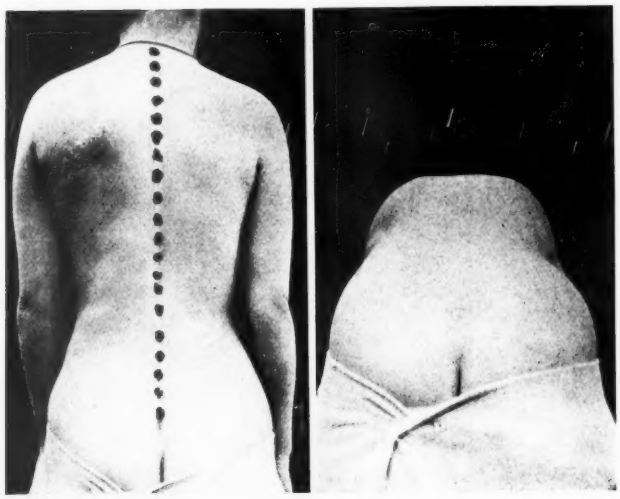


Fig. 22. Standing before.
Fig. 23. Bending before.
Fig. 24. Over-corrected in plaster, standing.
Fig. 25. Over-corrected in plaster, bending.
Fig. 26. Over-corrected, plaster removed, standing.
Fig. 27. Over-corrected, plaster removed, bending.

and windows are cut (Figs. 7, 8, and 9) so that felt may be inserted to push the patient into the position of over-correction.

The placing of these felt pads is shown best by a diagram (Fig. 10). In many cases after the rotation has been removed the lateral curve, which is more persistent, may be pushed into the over-corrected position by cutting out beneath the shoulder and over the hip and inserting felt pads on the opposite sides (Figs. 11, 12, 13). The length of time necessary to hold the patient in an over-corrected position in order for the structure to change depends upon the severity of the deformity. In one of moderate degree the following rules, which are best illustrated by the history of a corrected case, have seemed to produce the best results, but they are subject to change, and further experience may cause a complete modification of them.

Girl, eighteen years of age, with a fixed right dorsal curve, slight compensatory lumbar (Figs. 14, 15). Partial over-correction obtained when first corset was applied; felt pads inserted at intervals



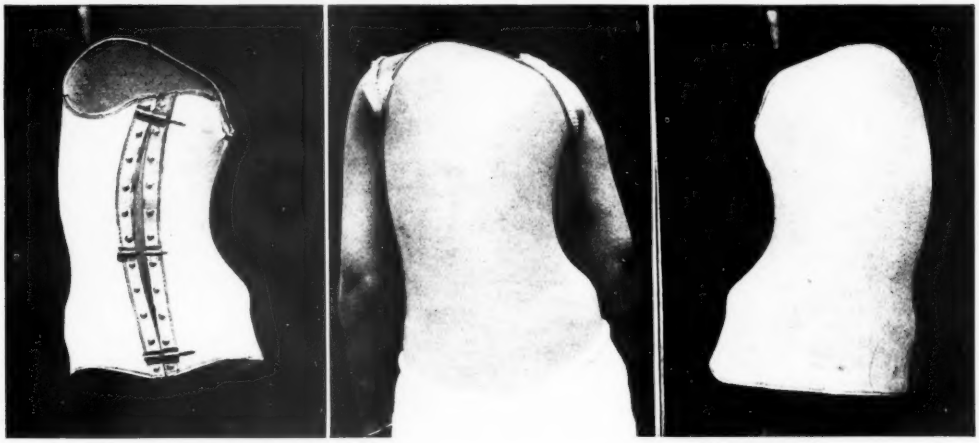


Fig. 28. After three months' exercises, standing
Fig. 29. After three months' exercises, bending.
Fig. 30. Celluloid corset, front view.
Fig. 31. Patient in celluloid corset.
Fig. 32. Celluloid corset, back view.

of about one week; corset worn five weeks, at the end of which the rotation was completely over-corrected, but some lateral bending remained. New corset applied and worn for four weeks. At this time there was full over-correction (Figs. 16, 17) and the patient was allowed to remain in this position for four months. The plaster corset was then removed (Figs. 18, 19), a celluloid corset substituted, and she was given exercises (Figs. 20 and 21).

The question naturally arises at this point, can all cases of fixed lateral curvature be over-corrected? There are a large number of cases where the deformity is so extreme that it is futile to attempt to completely reduce it. On the other hand, it seems conservative to say that nearly all patients present themselves to the orthopedic surgeon for treatment, and he usually has them under his care, long before the distortion has reached a stage where it is impossible to obtain over-correction. In other words, it seems possible

Fig. 33. Standing before.

Fig. 34. Bending before.

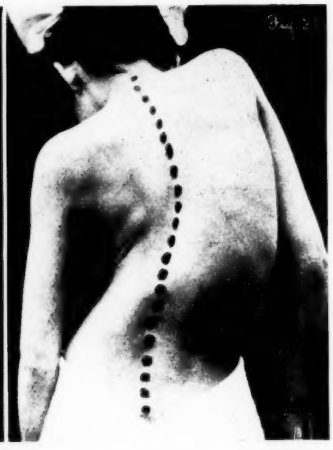


Fig. 35. Standing, extreme over-correction.

by this method to correct the deformity in all cases before it has become so extreme that only partial relief can be obtained, as most patients are under close observation during a period of years prior to that stage when they become hopeless.

There are many factors to be found in severe cases which make the reduction difficult and must be taken into consideration, yet careful attention to details will frequently make possible an over-correction which at first seems doubtful, and the history of a case in which reduction might seem impossible perhaps shows best what may sometimes be accomplished.

Fig. 36. Bending, extreme over-correction.

Girl, sixteen years of age; deformity first noticed in early childhood; has worn plaster corsets for some time without benefit (Figs. 22 and 23). Plaster corset applied with partial reduction on the frame; felt applied at intervals; corset worn six weeks with some deformity still present. Another corset applied and a better position obtained; felt inserted to push the spine into the over-corrected position. Corset worn two months and at time of removal over-correction had been accomplished. It was thought best, however, to increase the over-correction, so another corset was applied and by inserting felt at intervals for four weeks the spine was turned in the opposite direction to a degree almost as extreme as the original deformity (Figs. 24 and 25). Corset allowed to remain for five months, then removed (Figs. 26 and 27) and patient given exercises (Figs. 28 and 29).

In the presentation of this method by other surgeons the criticism has been made that the reduction of the dorsal curve produced an increase in the lumbar, or vice versa. In those cases where there is already established a compensatory curve, it is necessary to place another strap around the body so that traction may be made to prevent, or even remove, the compensatory curve, and if this rule will be followed it will obviate the difficulty.

The after-treatment of the reduction is as difficult as that of club-foot, and must continue over a long period. It is necessary to apply some form of apparatus which will hold the patients in the position of over-correction and they must be removed from it daily for

exercises. The use of the celluloid corset (Figs. 30, 31, and 32) has seemed to produce the best results, and in the average case it is worn continually for six months and then either day or night for the following six months. During this whole period proper exercises must be given at least once daily. That it is possible to over-correct the deformity very rapidly has been fully demonstrated, but there is danger in applying too much force and more time should be taken than was used in the cases which have previously been reported.

The amount of over-correction which can be obtained in a case suitable for reduction seems limited only by the shape of the plaster corset, the amount of felt inserted, and the length of time employed to accomplish it.

Girl, age fourteen; deformity fixed but not extreme (Figs. 33, 34). Corset applied and worn for eight months with felt inserted at intervals during the first four months. At the beginning of the ninth month the corset was removed. Patient showed marked over-correction, both in the lateral bend of the spine and in rotation (Figs. 35, 36).

That it is possible to remove the deformity in most cases of fixed lateral curvature — excepting the extreme type — seems possible; there are, however, many of the details of this method which can be improved upon and with this improvement less time will be consumed and better results will be obtained.

THE TREATMENT OF LATERAL CURVATURE OF THE SPINE[1]

A Discussion of Dr. Abbott's Paper

By ROYAL WHITMAN, M. D., New York City

I SHALL assume that a formal discussion of a treatment that has attracted such general attention should be rather an account of personal experiences and impressions than a criticism of the subject as presented, particularly as Abbott's views had not changed materially in the interval between the publication of the original article and that which appeared last April. In this latter paper the statement is reiterated and emphasized without qualification that the deformity of lateral curvature of the spine may be more easily and quickly corrected than that of club-foot or bow-leg. This proposition is supported by the histories and photographs of 18 cases, in many of which the deformity was apparently of an advanced type. Yet the average time required for correction was but three weeks, and for subsequent fixation but two months. It was further stated that cure, which was apparently accomplished in all the cases, implies restoration to the normal condition.

Soon after the appearance of Abbott's first paper in June, 1911, I had the opportunity to see the treatment demonstrated by him in Portland. It was at once begun tentatively at the Hospital for Ruptured and Crippled, and during the past year it has been thoroughly tested under favorable conditions.

The supply of material to illustrate types of deformity and for selection and comparison is practically unlimited. We have been fortunate also in having at hand men of ability and experience to apply the treatment, both in the out and indoor departments. They have attempted to follow Abbott's directions and have had the further advantage of his personal demonstrations and instruction. In this connection it may be mentioned that although the attitude of antero-lateral flexion is novel, the rudiments of the technique at least are fairly familiar, since jackets with openings for pressure and for expansion of the chest applied in the horizontal attitude to permit better primary correction of the spine have been in use for years.

At first the jackets were applied on the

[1] Read before the Third Clinical Congress of Surgeons of North America, New York City, November 15, 1912.

ordinary frame then used by Abbott, but during the summer the perfected apparatus, kindly furnished by him, has been in use in the hospital wards. The cases selected have been of fixed deformity, varying from moderate to severe. Several of the patients were children and a few were adults. All the others were adolescents of the class to which the popular accounts of the treatment would naturally appeal. An average of 40 cases have been under observation during the summer and the effects of the treatment have been carefully checked by casts of the spine and by X-ray pictures. While it would not be claimed that the method has been as effectively applied as it might have been under Dr. Abbott's supervision, still the test has the value of representing the ordinary experience, and it is therefore of the character that must eventually determine the range and applicability of any surgical procedure that is to come into general use.

With these qualifications, it may be stated that our observations do not justify the claims of Dr. Abbott. The deformity of fixed rotary lateral curvature is far more difficult to correct than is club-foot, while bow-leg offers no standard of just comparison. Many cases in adult life, for example, are so consolidated by time and by accommodative changes that correction is out of the question.

Many cases in young subjects, particularly the high dorsal curves with sharp backward angulation of the ribs, can neither be cured nor greatly improved; and certain deformities of the more common type of rachitic origin are, in adolescence, almost equally resistant. Lateral curvature of the moderate grades can be much improved or eventually cured, the most favorable class being the long dorsal curves with but slight compensation. In certain cases of this type the deformity may be rapidly overcorrected, according to photographic and X-ray evidence, but it will relapse with far greater rapidity when the support is removed.

It is therefore not only in the range of effectiveness, but in the time required even to correct deformity, which is simply the first step toward cure, that our experience differs from that of Abbott. This is an important point, for whereas other forms of treatment have the advantage of immediately improving the patient's appearance and carriage, this produces a noticeable and even grotesque deformity, while the stooping attitude. the flattened and compressed chest, are, from the hygienic standpoint, undesirable to say the least. Furthermore, the treatment is always uncomfortable and often painful.

The patients are excluded by reason of their appearance from ordinary occupations and amusements. They are disinclined to exertion and are often unable to sit or stand for any length of time, but kneel or recline or assume other peculiar positions for comfort. Sleep is often disturbed; pain in the neck and arms is very common, and palpitation and embarrassed respiration are not infrequent. Eventually the patients resign themselves to the inconveniences and discomforts of the treatment, but the pain is usually renewed whenever the pressure is increased. If the ribs were equally resistant the problem of progressive correction by this means would be simpler, but the anterolateral part of the chest is very flexible and it may be easily flattened or incurved by pressure. I have seen, for example, the beating of the heart plainly visible beneath the posterior chest wall, displaced by a pressure that had but little effect upon the deformity of the true ribs.

The discomforts or even dangers of the corrective treatment would be of little moment if it were limited to a few weeks, but when it must be prolonged for many months to induce even an improvement, time becomes a serious consideration.

If it be assumed that the treatment at the hospital has been conducted with only the average misconceptions and blunders that usually attend the introduction of a new method, a literal acceptance of Abbott's statements can but lead to disappointment and discouragement, since no treatment can transcend the natural laws that govern the reconstruction of deformed and distorted tissues.

From a more rational standpoint, however, the conclusion is very different. Cases may now be improved or cured that formerly were

not susceptible to improvement or cure, indicating not only the greater efficiency of the method, but that the changes incidental to deformity, even of long standing, are less resistant than has been believed.

It has been proved already, I think, that the underlying principle of the method is correct, namely, that as lateral curvature is essentially a flexion deformity, rotation should be more easily reduced in flexion than in extension, and that deformity should be corrected before functional activity is permitted.

When this principle is generally accepted, corrective treatment will be applied at a time when it may be effective, and gymnastic exercises, now a futile routine, will find their proper place in the prevention of deformity and as a necessary adjunct in the after treatment.

I think we are indebted to Abbott not only for a more effective means of correcting deformity, but for the emphasis that this treatment has laid upon a surgical principle. And even though one must differ from him on the questions of its scope and limitations, it will be admitted that his enthusiastic presentation of its merits is in great degree responsible for the renewed interest in this neglected subject.

THE SURGICAL TREATMENT OF PELVIC THROMBOSIS OF SEPTIC ORIGIN

By HENRY JELLETT, M. D., F. R. C. P. I., Dublin, Ireland
Master Rotunda Hospital

THE treatment of puerperal pyæmia is of such extreme importance that no apology is required for a contribution to its literature, and any procedure that even offers at first sight a hope of an improved mortality rate is worthy of careful consideration. Even if we take a mean of the mortality rates that have been recorded in the past as following expectant treatment, the percentage is very high, and, if we regard it as something between sixty and seventy per cent, we shall probably not be wrong. Further, we may probably consider the mortality of those cases in which there is suppuration in the veins to be almost one hundred per cent. The introduction of serums and vaccines has on the whole been of little use. In other forms of septic infection they have done undoubted good, but in puerperal pyæmia, once thrombosis is established, their effect appears to be small. It is little wonder then that many operators have turned their attention to the possibility of successful interference by surgical treatment. I do not propose here to enter into the history of the surgery of pyæmia of pelvic origin. Those who desire to study it, and it is most necessary that anyone interested should do so, can learn it far better from Professor Whitridge Williams' writings than they will from me, and to those writings I refer them. I regard my present paper more as an addendum to the monograph on the subject which he published in 1909, and as adding my own personal experience to the facts which he has there collected and published.

We shall not be far wrong if we divide the graver forms of puerperal infection into two classes. In the first class, bacteria pass rapidly in large numbers into the blood vessels or lymphatics, and their virulence is so acute, or the resistance of the patient so diminished, that a general spread of bacteria through the body occurs at once and unchecked. In this class there is no place for surgical treatment. In the second class of infection, either owing to the lesser virulence of the bacteria or to the greater resistance of the patient there is time for protective efforts to occur, and to tend to check the spread of infection from the uterus to the general system. This protection usually takes the form of phlebitis and throm-

bosis in one or more of the pelvic veins, and in the thrombi for a time the invading bacteria are locked up. Sometimes the bacteria disappear and the patient gets well. More usually, however, the thrombi gradually break down and emboli containing bacteria make their way into the general circulation. When this occurs the symptoms of the patient are well marked. They consist of rapid elevation of temperature, marked increase in the pulse rate, and the occurrence of rigors. The passage of the infection into the general circulation is intermittent and for a time the patient is capable of dealing with it, so that in a few hours the symptoms lessen, the temperature falls, the pulse becomes less frequent, and the patient returns almost to a normal condition. In a little time, however, varying from a few hours to some days, a fresh auto-inoculation occurs followed by the same symptoms. Such inoculations are repeated at ever shortening intervals, foci of infection occur in distant organs, and finally the patient succumbs. For the first class of infection we in Great Britain have no very satisfactory name. Abroad it is termed acute pyæmia. Here it is known variously as lymphatic sepsis, fulminating sepsis, acute general sepsis, to all of which terms there are objections. The second class of infection we usually term pyæmia, while abroad, where the first class is termed acute pyæmia, the second class is termed chronic pyæmia. It is with this condition I am concerned here, because, as the results of other operators show, and as the personal experience that I am able to bring before you to-night also shows, there is a distinct and hopeful place in it for surgical interference.

In 1911, two patients died in the Rotunda Hospital of pyæmia, in one of whom, prior to death, a diagnosis was made of cellulitis in the region of the right utero-sacral ligament. In both of them at the post-mortem examination thrombosis was found in the ovarian veins. I accordingly decided that, if there was another case presenting similar symptoms, and if there was any reason to think that thrombosis had occurred, I would interfere by operation and try to remove the affected vein or veins. Since then, I have had to deal with four cases. In three of them an almost positive diagnosis of thrombosis was made before the operation, both from the physical signs and from the symptoms of the patient. In the fourth case, no evidence of thrombosis could be found, but the symptoms of the patient so strongly suggested the possibility of thrombosis that I opened the abdomen to explore.

Case 1. C. M., aged 30; was admitted to the hospital on February 16, 1912. Her previous history does not call for special note. She was in her eleventh pregnancy and was practically at full term. Her health during pregnancy was described as fairly good, and on admission as good. She was confined normally the day after admission, two vaginal examinations having been made by the same nurse the day previously. On the sixth day, her temperature rose to 101.6° F. and her pulse to 98. The uterus was douched and a culture taken, in which no organisms could be found. Her temperature fell to below 100° F. and remained there for two days subsequently, but on the evening of the eighth day she had a rigor, her temperature rising to 102° F. The lochia was normal. The next day she had another rigor, her temperature rising slightly higher. The vagina and uterus were again douched, some small shreds of decidua and membranes being removed. The uterus was also plugged with iodoform gauze. In the material removed, diplococci were seen. The temperature fell to normal and remained so during the following day. On the eleventh day, five millions of a stock streptococcal vaccine were given. On the thirteenth day she had another rigor, and between this and the fifteenth day, rigors occurred at short intervals. On the fifteenth day, I examined her bi-manually and found a swelling in the right broad ligament. This swelling was not adherent to the pelvic brim, and did not suggest a cellulitis. It was about the size of an egg. Taking this swelling in association with the continued rigors, I decided to open the abdomen, and I did so a few hours later. I then found a hard, brawny swelling in the right broad ligament, that could be traced to the infundibulo-pelvic ligament and along the course of the ovarian vessels upward beside the lumbar vertebræ. The tube was congested, but otherwise normal. I tied the uterine end of the broad ligament, and incised the peritoneum over its face, and then with a little dissection was able to enucleate the mass in the broad ligament and to trace it upwards along the course of the ovarian vessels, until I got up almost to the insertion of the vein into the vena cava. I tied the vein as high as possible and then removed the whole mass. The operation was extremely simple, the only trouble that occurred being caused by the division of the ovarian artery when I divided the vein. It was, however, easily caught and tied. It is noteworthy that I was not able to get completely above the clot

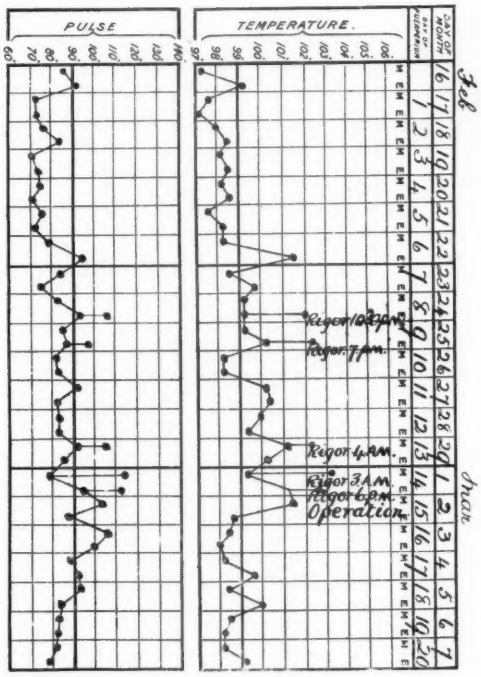


Fig. 1. Temperature chart of Case 1, C. M.

in the ovarian vein, and that my incision passed through it. The after-history of the patient was entirely satisfactory. Her temperature fell to normal almost at once, and her pulse to normal in a few days (*vide* Fig. 1). There was a slight recurrence of temperature on the twenty-sixth day, lasting for about a week, associated with some cellulitis in the remains of the broad ligament. It quickly, however, fell to normal, and the patient left the hospital well on the forty-first day after the confinement, the temperature and pulse having then been normal for more than a week.

I append to this paper Dr. Rowlette's report of the specimens which were removed, and all I need say here is that the swelling in the broad ligament consisted of the thrombosed branches of the ovarian vein, and that the main trunk contained pus in its lower part, while its upper part was occupied by a thrombus that had not yet broken down (*vide* Fig. 2).

Case 2. M. D., aged 26; was admitted to the hospital on October 6, 1912. She was in her third pregnancy and at full term. She was confined on the following day, there being a slight tear of the

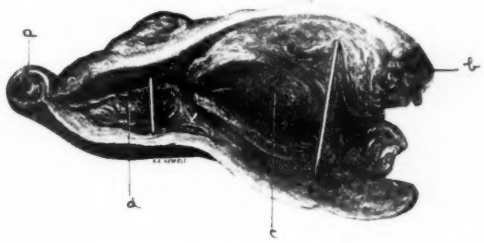


Fig. 2. Thrombosed ovarian vein and right broad ligament removed in Case 1. *a*, proximal end of ovarian vein containing thrombus; *b*, fimbriated extremity of Fallopian tube; *c*, ovary in section; *d*, lumen of dilated ovarian vein containing breaking-down clot.

perineum which required one suture. During the labor two vaginal examinations were made. The patient said that during pregnancy she had had a yellow discharge, for which she had on several occasions attended another hospital. The perineal suture was removed on the seventh day, up to which time her temperature had never exceeded 100° F., or her pulse 90. The perineum had not, however, healed. On the eighth day, the lochia were slightly fœtid and the uterus was douched. Next morning her temperature was 101° F., in the evening it fell to 100, and the next day to normal, where it remained for three days. During all this time, on only one occasion was her pulse above 90, and for the most part it was below 85. On the thirteenth day her temperature rose in the evening to 101° F., and the next morning to 104° F. There is nothing on the chart at this time to show that she had had a rigor; her pulse still remained slow, only on two occasions registering above 90. The lochia, which had been normal for some days, ceased. On the evening of the sixteenth day the temperature again fell to normal, but on the following evening it rose to 101.8° F. On the eighteenth day of the puerperium, she had a temperature of 104.5° F., with a rigor. The next day there were two rigors and one or more on each of the following days. On the twenty-first day in the evening both temperature and pulse fell to subnormal and remained so for some twelve or eighteen hours. In the middle of the next day, however, she again had a rigor. Rigors continued for the most part at intervals of a couple of days until the twenty-ninth day, when they became more frequent until the thirty-second day, from which day to the thirty-seventh there was a decided drop in both temperature and pulse, and an absence of rigors. On the thirty-seventh day, the temperature rose again, and rigors occurred on the thirty-eighth and the thirty-ninth days (*vide* Figs. 3, 4, 5). All this time she was getting streptococcal vaccine every second day in doses of 5,000,000. During this time I had been laid up, and on my return to the hospital on her thirty-ninth day I examined her, and felt on one side a tense cordlike structure

lying approximately in the course of the ovarian vessels. I accordingly came to the conclusion that I was dealing with a thrombosed vein, and decided to operate. In this case the condition I found was entirely different from that found in the first case. There was no cellular infiltration of the broad ligament. There was thrombosis of the initial tributaries of the right ovarian vein, but this thrombosis extended very little if at all above the infundibulo-pelvic ligament. The ovarian artery, however, presented extremely thick walls. Its lumen was closed and blood did not pass through it. I extirpated the broad ligament and the ovarian vessels as high as I could reach, but here again I had to leave the last inch or so. The immediate result of the operation was beneficial. Rigors ceased for two days, the temperature remaining below 101° F. as shown by the twelve-hourly taking. On the second evening after the operation, however, the temperature rose to 102° F. and the following day a rigor occurred, followed by another the next day. There was then a period of some intermission for about five or six days until the fiftieth day when another rigor occurred, followed four days later by another. During this period the patient's temperature fluctuated considerably and I feared the operation was not going to be a success. However, on the fifty-sixth day the temperature and pulse both became normal and remained so permanently, the patient leaving the hospital quite convalescent. The report of the structures removed appears later. It will be noticed that the most marked lesion was in the ovarian artery (*vide* Fig. 6).

The third case was almost of an identical type to the first, except that it was allowed to go on longer before operation and that in every way it was more severe. It ended fatally.

CASE 3. K. W., aged 23, was confined in the hospital on January 2, 1913. On the third evening her temperature was 99.5° F. The next morning her pulse was 100, though her temperature was only 98° F. The lochia, however, was somewhat fœtid, and in the evening she was douched. On the next two days both temperature and pulse were normal, so that up to the sixth day on only one occasion had her temperature exceeded 99° F., and on only one occasion had her pulse reached 100. On the seventh evening she had a rigor, her temperature rose to 104° F. and her pulse to 135. The rigor occurred after a douche which was given because her temperature at the ordinary taking was 101° F., and her pulse 120. Her temperature was up again the following evening to 101° F. and the next evening to 103° F., with a pulse rate of 120. The next day, the eleventh, her evening temperature was normal and her pulse to 100, but during the night she had a rigor, her temperature reaching 104.5° F. and her pulse 142. From that day on up to the eighteenth, she had a history of recurrent rigors, with temperature varying between 105° F. and 98° F., and the pulse between 150 and 90 (*vide* Figs. 7, 8). On several occasions the uterus was douched, and streptococcal vaccine in doses of 5,000,000 was administered at regular intervals. Cultures taken from the uterus during this time, showed that streptococci and bacilli of different sorts were present. I examined her on the eighteenth day and found a definite thickening on the right of the uterus. This thickening possessed similar characteristics to that met with in the first case, but it could be palpated above the pelvic brim distinctly extending upwards along the course of the ovarian vessels. I came to the conclusion that I was probably dealing with thrombosed veins and decided to operate.

On opening the abdomen, I found a very similar condition to that found in Case 1, except that it had gone very much further. Septic peritonitis was on the point of starting and there was dirty semi-purulent fluid lying in the lower part of the peritoneal cavity. The right broad ligament was brawny and thickened, the tube in a congested state, but otherwise normal, running along the top of the ligament. The thickening extended upwards along the infundibulo-pelvic ligament and then along the side of the lumbar vertabræ following the course of the ovarian vessels. I removed the broad ligament in a similar manner to that adopted in the first case, and I followed the ovarian vessels upwards as far as I could (*vide* Fig. 9). Along their course I found two small abscesses with pus indicative of a coli infection. The wall of the vein was very friable and when I had removed about four inches of it, it broke across. A further piece was then removed separately. Pus exuded freely from the broken ends of the vein. I closed the peritoneum as far as possible over the bed of the vein. I drained the small abscesses in the flank through an incision in the flank, and I drained the pelvis both through Douglas' pouch and through a rubber drainage tube in the lower end of the abdominal wound. The last named was put in because so much of the infection lay above the brim of the pelvis.

The patient stood the operation fairly well, and the following day her temperature never rose above 101° F., her pulse maintaining a level between 120 and 140. This, however, was not surprising, as after the operation her pulse was 160. The following day, however, her temperature at 8 P. M. reached 105° F. and she had a rigor, her pulse rate reaching 150. The next couple of days she was better, but the next — the twenty-third day of the puerperium — she had another rigor. For four days she then ran a decidedly better course. There was no marked fluctuation of temperature, which remained approximately about 102° F., her pulse rate ranging between 110 and 130, at odd times reaching 140. On the whole, although her condition indicated the presence of pus somewhere, still it was fairly satisfactory, considering her state at the time of operation. She, however, developed a superficial œdema at the upper part of the right thigh and in the right

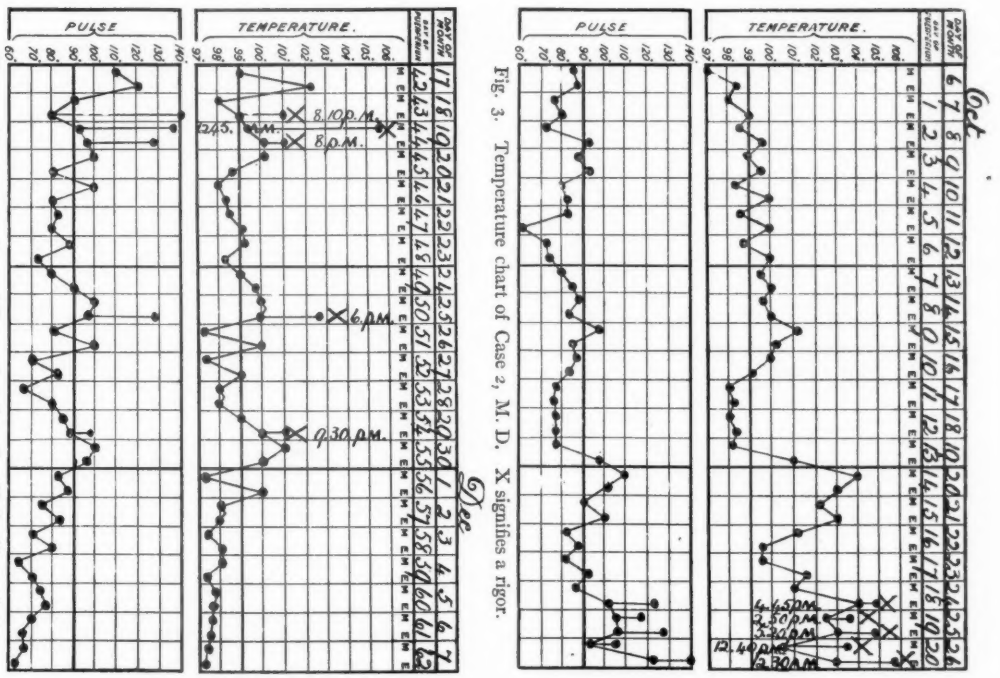


Fig. 3. Temperature chart of Case 2, M. D. X signifies a rigor.

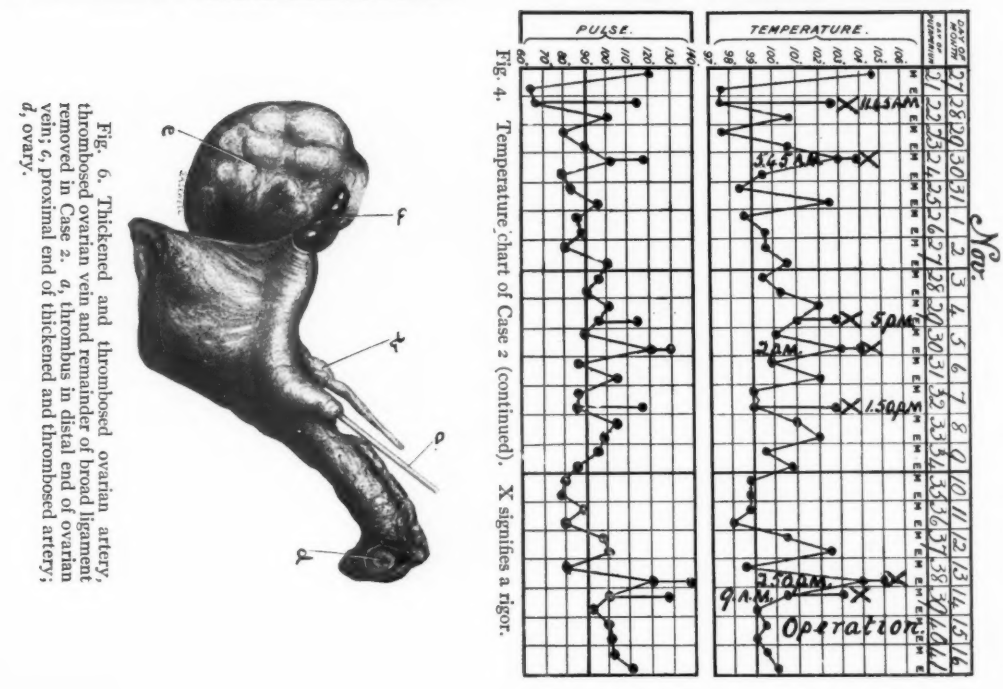


Fig. 4. Temperature chart of Case 2 (continued). X signifies a rigor.

Fig. 5. Temperature chart of Case 2 (continued). X signifies a rigor.

Fig. 6. Thickened and thrombosed ovarian artery, thromboses ovarian vein and remainder of broad ligament removed in Case 2. *a*, thrombus in distal end of ovarian vein; *c*, proximal end of thickened and thrombosed artery; *d*, ovary.

labium majus, which made us suspect the occurrence of further thrombosis.

On the twenty-ninth and thirtieth days she was not so well and had several rigors. On the thirty-first day I again examined her and I found that there was a good deal of thickening in the region of the right uterine vessels, and that there was a ridge as thick as one's finger running along the right wall of the vagina beneath the mucous membrane, and suggesting an enlarged and possibly suppurating vein. The condition of the patient was very bad but I thought that the only possible chance was a further operation, and so the same day I opened the abdomen a second time. I thought it was possible I should find thrombosis in the internal iliac, and I decided, if so, to ligature it. On opening the abdomen, however, I found that owing to the thickening of the tissues of the posterior wall of the pelvis, the result of the previous operation, it was impossible to identify the veins, and that there was certainly no thrombosis — at any rate, in the upper part of the internal iliac. The site from which the ovarian vein was removed was in a comparatively healthy state, and the general peritoneal cavity was quite healthy. The thickening around the uterine vessels was very obvious, and so I cut down on to them along the right side of the uterus, and came to a small collection of pus round the vessels. I cut the latter across and I think pus came out of some of the veins. I found the pus burrowing outwards along the course of the vessels, and also following them inwards into the uterus. I therefore decided to remove the uterus and did so. I also drained the abscess under the vaginal mucous membrane, which, from the course it ran, appeared to lie in a vein. On examining the uterus subsequently the mucous membrane was in a sloughy condition suggesting a septic endometritis. The patient stood the operation well, considering her state, and after it her pulse steadily fell until at 8 A. M. the following day it was only 110, and her temperature 98° F. She slept well during almost the entire night. From 8 A. M., however, both temperature and pulse began to rise, and at 8 P. M. her temperature was 104° F. and her pulse 150. The next day her condition was very much what it had been prior to operation, repeated rigors, a temperature ranging between 104° and 105° F. and a pulse rate reaching up to 160. I did not expect her to survive that night, but to my surprise, the next day she seemed decidedly better. The improvement, however, was only temporary, and on the thirty-fifth day she began to show signs of septic infarctions in the lungs, and died on the forty-second day.

Now in spite of this result I consider that this case, in no way contra-indicates operation in such cases, but rather that it shows that operation is distinctly advisable. I have no doubt in my own mind that, if the patient had not been operated on the first time, death would have resulted in a comparatively short time. Septic peritonitis was just starting, and pus was apparently discharging freely from the ovarian vein into the vena cava. I think that if I had operated at an earlier date, when the condition present more resembled that found in my first case, the patient's life might have been saved. Even as it was, she got over the first operation most satisfactorily; there was no attempt at septic peritonitis, and, had it not been for subsequent thrombosis extending from the uterus into the other veins, I think that her life would have been saved.

It will be noted that in each of the three foregoing cases there were definite physical signs found before operation, in addition to the presence of intermittent high temperature and recurrent rigors. I will refer again to the nature of the physical signs and their value as a diagnostic element. The fourth case I have left to the last because, as I have already mentioned, I operated here in the absence of physical signs though in the presence of definite pyæmic symptoms.

CASE 4. M. N., aged 26; was admitted to the hospital on September 11, 1912. It was her first pregnancy and she was at full time. Labor occurred a few days after admission, the patient having been examined twice by the same nurse. The labor was normal save for laceration of the perineum which was sutured with several sutures of silkworm-gut. The patient's temperature remained normal until the fifth day when she had a rigor in which the temperature reached 104.5° F. and the pulse 120. The uterus was douched and found to be empty. A culture was taken and diplococci were seen to be present. The perineum was found to be very unhealthy, and the stitches were taken out and the wound dusted with iodoform. The next day she had another rigor, the temperature reaching 103° F., and the following morning a third, the temperature reaching to the same height. The following day in the evening, the temperature rose to 104.5° F. and the pulse to 110, but the next morning both were normal. Vaccine injections were begun on the sixth day and continued every second day throughout — streptococcal vaccine in doses of 5,000,000 being given until the twelfth day, when a staphylococcal vaccine was also given in doses of 25,000,000. On the tenth day the patient again had a rigor followed by a second on the eleventh day. On the twelfth day, I decided to operate though I could not get any definite physical signs. On opening the abdomen the broad ligaments were found to be normal and there was no thrombosis in any of the

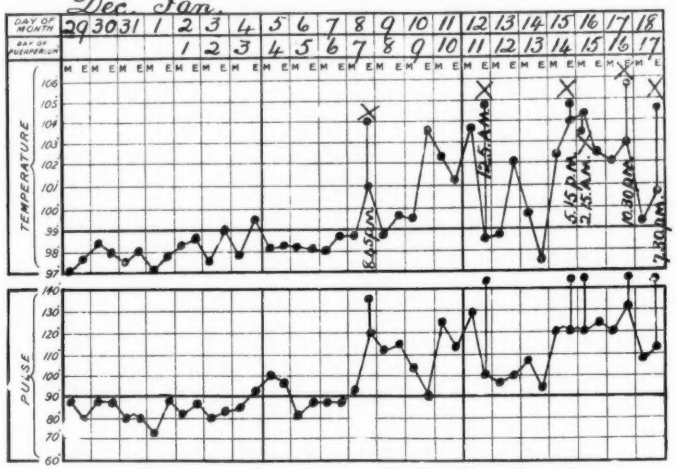


Fig. 7. Temperature chart of Case 3, K. W. X signifies a rigor.

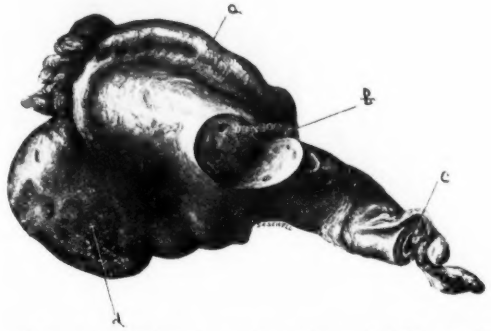


Fig. 9. Thrombosed ovarian vein and right broad ligament removed in Case 3; *a*, Fallopian tube; *b*, infiltrated connective tissue of broad ligament traversed by thrombosed and suppurating branches of ovarian vein; *c*, proximal end of vein dilated and containing pus; *d*, ovary.

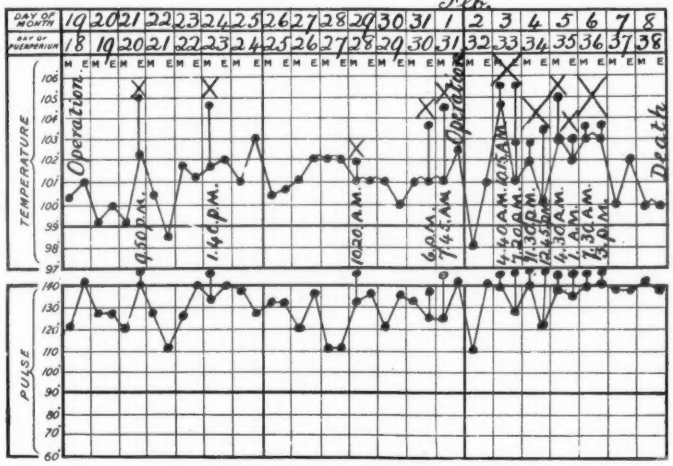


Fig. 8. Temperature chart of Case 3 (continued).

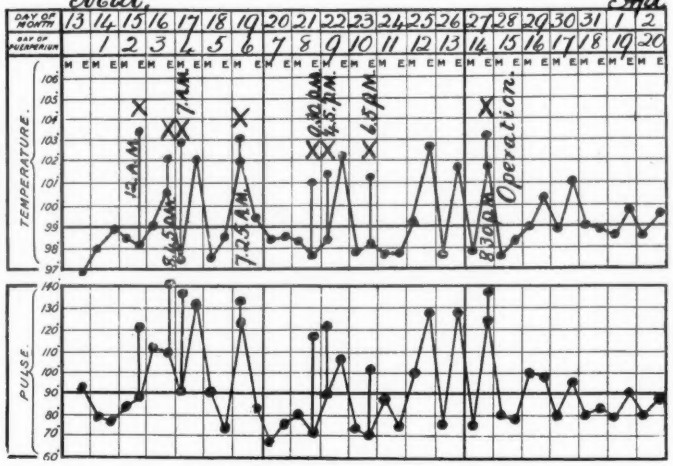


Fig. 10. Temperature chart of Case 5, M. McC.

pelvic veins. The uterus was large, and, taking the history of the patient into account, I came to the conclusion that it was the probable source of the infection, and therefore performed hysterectomy. The patient stood the operation, which was a short one, well, and for the next few days seemed to be rather better. However, on the fourth day after operation, high temperature again occurred reaching 104° F. with pulse varying between 120 and 130. A very fluctuating temperature followed for the next week, culminating on the twelfth day after operation in a temperature of 106.2° F. and a pulse rate of 148. At this time she had several rigors. The next day the temperature dropped and she appeared better, but, the day after, a relapse again occurred and for the next three weeks her temperature chart is a series of up and down lines with a maximum of 106° F. and a minimum of 97° F. Vaccines were administered throughout but produced no effect. The patient's condition gradually became worse, and, on the thirty-eighth day, she died. The report of the post-mortem examination is given later.

Here, it is enough to say that thrombosis of the pelvic veins and principally of the ovarian veins was found, and that, if I had looked for this and had operated a second time, it is quite possible her life might have been saved. As this paper deals primarily with the operative treatment of pelvic thrombosis, and, as there was no pelvic thrombosis present at the time of operation, I exclude the case from present consideration, and confine myself to the first three cases.

The first point that strikes one is that I was lucky in the type of case with which I had to deal. If one studies Professor Whitridge Williams' paper to which I have already alluded, the point that is most strikingly brought out is that, as one would expect, the greater the number of thrombosed vessels, the worse the prognosis after operation. Thus, thrombosis of the lower portion of the vena cava is always fatal. Thrombosis of the internal iliac veins at both sides is almost always fatal. Thrombosis of one internal iliac vein gives a slightly better prospect of success. Thrombosis of both uterine veins is less positively fatal than thrombosis of the internal iliac vein, but still it is a most serious complication. Thrombosis of one uterine vein is less serious and thrombosis of one ovarian vein is the least serious of all. Indeed, in the last class of case, Professor Williams places the mortality after operation at only ten per cent. We must therefore accept positively that my cases were the most suitable one could have for operation. It is, however, not unimportant to note that in these three cases, and in the two fatal cases which occurred before operation was undertaken, it was the ovarian veins alone that were affected, thereby suggesting that this is probably the most frequent site of thrombosis in puerperal pyæmia, and also suggesting that the greater part of the placental site normally drains through the ovarian and not the uterine veins. Assuming that my cases were favorable for operation what might one reasonably expect to have been their termination if expectant treatment had been adopted? I think there can only be the one answer to this question. In the first case, a few days would have seen a discharge of pus through the ovarian vein into the vena cava. In the third case, we have practically the first case repeated, but seen at a later stage, and with the later complications. That is to say, the pus in the ovarian vein had almost reached, if indeed it had not completely reached, the vena cava, septic peritonitis was on the point of starting, and localized abscesses round the course of the ovarian vein had already occurred. One could hardly have had a more unsatisfactory case for operation and one certainly could not have looked for any favorable termination from expectant treatment. The second case admits of a little more doubt, but, in view of the persistence of the symptoms after operation, presumably as a result of continued infection from the portion of the ovarian vein that was left behind, one can have very little doubt as to what its termination would have been if left alone.

The method of operating which I adopted is not the only one. There are at least two other courses possible. One is to gain access to the vein in an extra-peritoneal instead of a transperitoneal manner. The defects of this procedure are, however, considerable and the results are worse than are those of the transperitoneal operation. I think this route has been abandoned, as has also operation through the vagina. The second course is to perform simple ligature of the veins instead of removal. This is a course which is apparently well

worthy of consideration, and indeed, in view of certain cases that have been already recorded, it is a question whether it is not sometimes the better method. Perhaps my second case was one of these and that here ligation would have furnished equally good results to extirpation. I cannot, however, think that in either the first or the third case it could have succeeded. It might and possibly would have cut off the infected emboli from the general circulation, but it would have left the patient with an infection of an extensive character in very close contact with the peritoneal cavity. The after-history would probably be one of pelvic abscess, if not of general peritonitis. The latter complication would in my opinion almost certainly have resulted in my third case. I should therefore be inclined to say that, if the thrombosis is associated with pus formation, or with extensive periphlebitic inflammation, extirpation of the veins should be carried out. Whereas, on the other hand, when one is dealing with thrombosis alone in which suppuration has not as yet begun, ligature may be sufficient. It is, however, rather hard to regard a course which entails the leaving behind of a septic focus, as a surgical procedure.

When one comes to deal with other veins than the ovarian, the question of ligature or extirpation is more important. In the case of the ovarian vein extirpation is almost as easy as ligature, but in the case of the uterine and more particularly in the case of the internal iliac veins, ligature is necessarily considerably more simple. One of the most recent papers which I have been able to find in which ligature of veins is dealt with, is that by Warnickros of Bumm's Clinic.[1] He considers that, where there is extensive thrombosis, the most favorable site for the application of the ligature is on the common iliac vein on the affected side. If the thrombotic process, as in some of his cases, extends above this point, the vena cava, he says, may be tied without fear of subsequent obstruction gangrene as a collateral circulation is undoubtedly established in such cases.

Without going into these cases which one recognizes as still open to question, I think that from the considerations I have brought before you, taken in conjunction with those collected by Professor Williams, one must admit that there is a most important place in the treatment of pyæmia for surgical methods. Of course, as a new line of treatment, it will be subjected to very careful criticism and examination, but I believe that in certain cases, at any rate, it will eventually be universally adopted. On the other hand, as an instance of an opposite opinion, I may quote Professor Hirst, who writes:—"I have very rarely seen a condition of the ovarian veins that called for their ligation or removal. Thrombophlebitis as the sole cause of an operation and as the only thing to be removed is not yet demonstrated to the majority of surgeons." If this means that the majority of surgeons have not yet looked for and so have not seen such cases, Professor Hirst's remark is of course true. If on the other hand it means that such cases do not occur, I think this paper proves its error.

The position of the matter at the present time is not that we have still to demonstrate the advisability of operation in suitable cases. I think we may definitely accept this. The real point is, how can we recognize the suitable case? Two factors help us — the symptoms of the patient and the results of a bi-manual examination. The occurrence of rigors, marked intermissions of temperature, fluctuations in the range of the pulse, are in all probability always met with in cases of thrombosis of septic origin. My fourth case, however, demonstrates, if demonstration is necessary, that similar symptoms may occur when thrombosis can not be found. I can also bring forward a case in which there was extensive thrombosis of the pelvic veins terminating in the death of the patient on the forty-second day after delivery, and in which only a few and very widely separated rigors occurred. It is thus evident that the symptoms of the patient may be insufficient or misleading.

There remains the bi-manual examination of the pelvis, and the experience of others appears to correspond with mine, that, with pelvic thrombosis present, one will find

[1] Archiv f. Gynäk, xcvii, h. 1.

definite and very fairly characteristic physical signs. The two conditions which one is most likely to confuse with thrombosis are, I fancy, pyosalpinx and cellulitis in the broad ligament — that is to say, cellulitis without thrombosis. I think in both these conditions one would expect, not so much recurrent rigors, as a more or less persistent range of high temperature associated with considerable pain. In the thrombotic cases, pain appears to be almost absent, except perhaps at the start of the thrombosis, when it is sometimes present along the course of the affected vein. Then, in cellulitis, the effusion in the broad ligament extends out to the pelvic brim and is firmly attached to the pelvic wall so that the broad ligament is very fixed. In the thrombotic cases that I have seen, on the other hand, even when there was a considerable amount of cellular infiltration round the thrombosed vein, the broad ligament was not fixed. Moreover, I think cellulitis is usually tender, and certainly a pyosalpinx in its acute stage is highly tender. In thrombosis, on the other hand, tenderness is not well marked, and when present is usually slight. I should then be inclined to say that a patient with rigors and an intermittent temperature and pulse rate, in whom a cordlike swelling can be found in the broad ligament or passing across the walls of the pelvic cavity, is positively suffering from thrombosis of the pelvic veins. Further, that if one finds, instead of cordlike swellings, one firm swelling, not markedly tender, not firmly fixed to the pelvic walls, not fluctuating, a diagnosis of thrombosis with considerable peri-venous inflammation may safely be made. How far one is justified in performing an exploratory laparotomy in the presence of marked pyæmic symptoms, when definite thrombosis cannot be felt by bi-manual examination, is another question. The case I record ended fatally, but I do not think that anyone who looks at the chart will consider that the operation in any way contributed to the patient's death. She rallied well from it, and, but for the later occurrence of thrombosis in the pelvic veins, I think one might have expected a good result. This case, however, raises the question of hysterectomy in pyæmia and this is another matter, with which for the time being I am not concerned.

REPORTS BY DR. ROWLETTE, PATHOLOGIST TO THE HOSPITAL, ON THE SPECIMENS REMOVED BY OPERATORS

CASE 1. C. M. The specimen removed is a conical mass of connective tissue, five inches in length, together with the *ovary*. The latter is large (2 inches in diameter) and soft, and shows a *corpus luteum*. The tip of the conical mass presents a vein, ¼ inch in diameter, filled with firm thrombus. One inch from the end, the vein wall has disappeared, and the surrounding tissue is broken down, leaving an oval abscess cavity, filled with pus. At the other end of the cavity the vein is again found, and is thrombosed. Several smaller veins are found embedded in the *connective tissue*, and filled with thrombi.

Microscopic examination. The *connective tissue* is densely infiltrated with polymorphonuclear leucocytes. The tissue along the *vein walls* is more densely infiltrated. The thrombi are also densely infiltrated. The contents of the abscess cavity show no sign of thrombus.

In smears of the *pus* a coccus and a Gram-negative bacillus were found. Cultures proved the latter to be *B. coli*.

The ovary is œdematous, and at the surface shows some infiltration with polymorphonuclear leucocytes.

CASE 2. M. D. The specimen removed consists of the ovary and part of the broad ligament. The *ovary* is normal in appearance. The *peritoneum* of the broad ligament is partially covered with a white purulent exudate. In the substance of the ligament is felt *a firm cord* four inches in length, as thick as a lead pencil. Close to it lies *a swollen vein* filled with firm thrombus.

Microscopic examination. The *ovary* is normal. The *cord* is found to be an occluded artery with thick walls. These walls consist chiefly of fibrous tissue, the outer coat being infiltrated with polymorphonuclear leucocytes. Contained in the tube is an organized thrombus.

The *vein wall* is similarly infiltrated, as also the contained thrombus.

The *connective tissue* of the broad ligament shows a minor degree of infiltration, and is congested.

Bacteriological examination was negative.

CASE 3. K. W. The first specimen consists of ovary, tube, and part of broad ligament. The entire mass is bright red in color, and covered with a purulent exudate.

The *ovary* is large, globular (2 inches diameter), soft, and œdematous.

The *tube* is thick and soft, and the fimbria are adherent.

The connective tissue of the *broad ligament* is firm,

and there is a cylindrical solid mass running from the ovary to the uterus. Embedded in this mass are several veins, which, on section, exude pus.

Microscopic examination. The *ovary* is œdematous and infiltrated with polymorphonuclear leucocytes. The *tube* is, as regards its outer coats, similarly affected, but the mucous membrane is normal. The *connective tissue* of the broad ligament is also inflamed, particularly in the solid tissue surrounding the veins. The *walls of the veins* are densely infiltrated.

The pus contained a large variety of cocci and bacilli, including *streptococcus* and various saprophytes.

The second specimen consists of the uterus. It is soft and œdematous, and shows a patch of inflamed and necrotic endometrium on the posterior wall.

Microscopic examination. The muscle of the uterine wall is œdematous and infiltrated with polymorphonuclear leucocytes.

The *endometrium* is also inflamed, and is necrosed in the patch mentioned.

Streptococci and various saprophytes were obtained by culture therefrom.

ADDENDUM

Since writing the foregoing, another case of pyæmia has come under my care, the features of which are so striking as to warrant very close attention.

CASE 5. M. McC., aged 27; in her first pregnancy, was confined on March 13, 1913. Two days later she had a rigor, and the rigors recurred practically at daily intervals, for fourteen days. Their general character will be seen from the chart (*vide* Fig. 10). On several occasions I made a careful pelvic examination, but could never find any evidence of thrombosis. She became gradually worse, and, on the thirteenth day, as she was rapidly going to the bad, I decided that I would operate. It was obvious that there was no thrombosis of pelvic veins, so that no question of excision arose. In view of the other case of a similar kind, which I have recorded in the foregoing paper (*vide* Case 4), I was not in favor of a hysterectomy, and so I decided to open the abdominal cavity and tie the ovarian vein, doing nothing else. My object in this was to cut off the supply of infected emboli that were coming from the placental site. Accordingly, I opened the abdomen on the fifteenth day after the confinement, and, as I expected, found no evidence of any intrapelvic or peritoneal trouble. I therefore ligatured both sets of veins, at the infundibulo-pelvic ligament, and divided them. The veins in the right broad ligament burst, presumably showing that they drained the placental site, and I had to retie them in a couple of other places, otherwise there was nothing special to record of the operation. The after-history of the patient is very clear from the chart. Two evenings after the operation there was a temperature of 100.5° F. and on the third evening a temperature of 101° F. It, however, fell to normal the next day, and the remainder of her convalescence was practically afebrile. I may also say that both before and after operation the patient received regular injections of vaccine.

PROSTATECTOMY [1]

BY JOHN B. DEAVER, M. D., SC. D., LL. D., PHILADELPHIA
Professor of the Practice of Surgery, University of Pennsylvania; Surgeon-in-Chief, German Hospital

ENLARGEMENTS of the prostate gland leading to urinary obstructions are due in the great majority of cases to benign hypertrophy. The condition designated as benign hypertrophy, in its application to prostatic disease, is a protean one, comprising a number of changes in the constituent parts of the prostate leading to enlargement of the organ which we must understand to appreciate the clinical details. Simple tumors of the prostate occur with great rarity, and its enlargements are usually due to increase in the epithelial or interstitial tissues, or both, with the production of fibro-adenomatous, fibromyomatous, and intermediate types of growths. When the fibrous and myomatous elements increase at the expense of the glandular portion, the result is the small, dense prostate in which the normal alveoli are diminished in size and number. If, on the other hand, the hyperplasia affects chiefly the glandular elements of the organ, the result is a soft, fibro-adenomatous, easily enucleable type of tumor. More or less chronic inflammation is frequently associated with prostatic hyper-

[1] Read before the Morristown Medical Club, Morristown N. J., March 26, 1913.

trophy and markedly influences both the symptoms and the ease of enucleation.

Benign hypertrophies, as stated above, may show every degree of gradation from the large, soft, and sometimes cystic tumor, which practically starts from its bed with the relief of the slight tension of the overlying vesical mucosa, to the absolutely non-enucleable fibrous type, small in size and of extreme density. These various changes may also be found in different areas of the same tumor, so that the size and density of a prostatic tumor to rectal examination does not absolutely settle the question of its enucleability, for a small tumor may be the miniature of the larger type and shell from its capsule quite as readily. Furthermore these small tumors may be so situated as to seriously obstruct the vesical outlet. These pathologic changes begin in different portions of the gland, but the effects of every enlargement result from encroachment of the tumor on adjacent structures. The primary change in the majority of cases, regardless of the point of origin of the growth, is an increase in the vertical diameter of the gland, with elevation of the vesical neck and alteration in the size, direction, and axis of the prostatic urethra. It follows that a prostate enlarged in its transverse diameters, a change readily determined by examination of its rectal surface, usually shows intra-urethral and intravesical enlargement as well; although the converse is by no means true, for a prostate normal in size per rectum may contain a small tumor at the vesical neck completely obstructing urination. The small fibrous prostate offers obstruction to urination as a rule by the actual diminution in the caliber of the prostatic urethra through direct pressure, rather than in a relative obstruction from alteration in the position of the vesical orifice or in the axis of the deep urethra, factors which are operative in adenomatous types of enlargement. The enucleability of hypertrophied prostates is largely dependent upon the pathologic change present in any given case, and the preoperative determination of this point is usually possible and should influence us in our choice of operation. The encapsulated and therefore enucleable adenomatous masses, markedly enlarged in the vertical axis and for this reason more accessible from above, are removed with surprising ease by the suprapubic route. On the other hand, the dense fibrous type, which comprises about 15 per cent of benign hypertrophies, lacks not only this comparative accessibility, but of greater importance lacks also an encapsulation that permits of its being shelled out. As we have stated, there are intermediate cases in which it is impossible to determine the best method of procedure, but as a general rule we are more often gratified to find a doubtful case easy of suprapubic enucleation than chagrined in mistaking the fibrous type for an enucleable one in the employment of the upper route.

Of all the means employed for the determination of the most appropriate operative procedure in enlargements of the prostate, the cystoscope is the most valuable one at our disposal. By its use we learn not only those most important considerations, the relation of the enlarged gland to the internal vesical orifice and the degree of intravesical projection, but also the condition of the bladder mucosa, the presence or absence of diverticulation, the location of calculi, which complicate about 14 per cent of cases of prostatic enlargement and determine their size and shape, and whether free or encysted, all of which factors influence to a degree the choice of operative procedure. Cystoscopic examination also furnishes detailed information of median prostatic projections, so frequently the cause of marked obstructive symptoms. It is of little practical importance whether these so-called median lobes arise from isolated lobules beneath the floor of the proximal urethra or from one or the other lateral lobes, but it is of the greatest possible importance for us to know, first, if such a condition is present, and secondly, if it is the cause of the patient's symptoms, and, as a corollary, the indicated procedure for its removal.

All of these questions can be answered in the interpretation of the cystoscopic picture when based upon wide experience with the use of this instrument in cases of prostatic enlargement. There are a number of instances in which the cystoscopic examination

is unsatisfactory or impossible, either on account of excessive hæmorrhage, inflammation and the associated irritability of the deep urethra and vesical neck, a complicating epididymo-orchitis, or in the presence of such marked distortion of the prostatic urethra that it becomes impracticable to traumatize the patient with forcible introduction of a straight and rigid instrument. Nor do I advocate the use of general anæsthesia to permit of a cystoscopic examination when severe pain and irritability of the bladder under local anæsthesia make the procedure impossible. As a rule, however, we gain more information of the prostatic obstruction and the legacies it has left on the bladder with a cystoscopic examination, and with no greater danger than is derived from the combined use of all other methods of examination. These latter, including rectal palpation, X-ray examination of the entire urinary tract, measurement of the urethral length, and estimation of the amount of residual urine, and of the capacity of the bladder must not be neglected.

An additional cause of urinary obstruction is found in a rigid condition of the perimeatal tissues of the internal vesical orifice. The consequent loss of elasticity and expansibility of the internal vesical sphincter obstructs the urinary outflow and gives symptoms indistinguishable from those due to early hypertrophy of the prostate. This condition, frequently an accompaniment of the fibrous prostate, is, I believe, most often the aftermath of an antecedent urethritis and prostatitis. Cystoscopic examination in these cases reveals little except the absence of true prostatic enlargement. The patients are improved after the forcible stretching of the tissues incident to the introduction of the instrument, and this gives us the key-note to treatment — dilatation of the deep urethra and internal vesical sphincter, under which the slight nocturnal frequency of urination and small amounts of residual urine disappear, and the patients, in the absence of a complicating infection, quickly return to normal bladder health.

Benign hypertrophies of the prostate are indistinguishable from carcinoma in its early stages. This applies not only to the clinical picture, but also to the differential microscopic diagnosis. An area of hyperplasia of the acini with its multiple layers of columnar and cuboidal cells, closely simulates carcinoma and the differential microscopic diagnosis between atypical adenomata and cancer is as difficult a one to make as in the analogous conditions affecting the mammary gland. Cancer of the prostate, like mammary cancer, may arise either in the unchanged gland or upon the basis of a pre-existent adenoma. In the former instance the condition presents no characteristic clinical symptom in the operable stage. The chief characteristics of the carcinomatous prostate are nodularity, increased density and immobility; these usually occur with little or no general increase in the dimensions of the organ, but regardless of size, there is a peculiar stony hardness to a carcinomatous nodule that is practically diagnostic, and assuredly so in the presence of fixidity of the gland. A nodular tumor of extreme and often irregular density firmly fixed to adjacent structures, especially to the rectal wall, and with continuous referred pains spreading upwards between the seminal vesicles, undoubtedly bespeaks carcinoma, but also assures us of the hopelessness of operative cure. When we speak of the absence of distinguishing signs in early cancer we have in mind the rich lymphatic supply which carries the malignancy beyond the limits of radical excision, long before a nodule is appreciable to rectal palpation. In a prostatic cancer arising from a pre-existent adenoma the signs suggestive of malignancy are often wanting, and we may remove a large, soft and easily enucleated tumor secure in our clinical judgment of its benignancy only to find malignant changes in the routine study of microscopic sections. Carcinoma is found in approximately 10 per cent of prostatic enlargements, so that this factor must play a large part in forming our opinion on the proper treatment of the individual with a hypertrophy of this gland. From 30 to 35 per cent of men beyond the age of sixty years have some degree of prostatic hypertrophy while in only 16 per cent of these individuals does the enlarged gland

give rise to clinical symptoms. It must be determined, therefore, in the first place, whether the urinary symptoms are caused by increase in the size of the prostate, and secondly, if the heart and kidneys of the patient will stand the strain of a prostatectomy. With these two important questions answered affirmatively to one's satisfaction, then, in view of the frequency of unrecognizable malignant involvement, I would retreat from my previous stand for judicious palliation and advocate earlier radical treatment. Every benign prostatic hypertrophy, especially if it is the cause of clinical symptoms, harbors the potentiality of cancer, and our advice should be, in the absence of positive contraindications, exactly the same as that given in cases of tumors of the breast-excision. I do not mean to say that every enlarged prostate should be immediately removed, but when a progression of the clinical symptoms demands our choosing between palliation and operation, I firmly believe that our advice should be for an operation of the radical type. Disregarding the inevitable cystitis and its train of complications during catheter life and for the single reason of an imminent danger of malignancy, we must not rest content with any palliative measures.

In advanced cases of carcinoma of the prostate with extensive bladder involvement, suprapubic cystostomy has given greater comfort than perineal drainage, but with either method the relief of suffering is slight. The method of choice for excision of prostatic cancer in the event of its early recognition is by the perineal route, and with the same reasons for its employment as apply to the nonenucleable form of benign hypertrophies. The object of such an operation remains as yet merely the relief of obstructive effects, for the radical procedures as advised by Young await more conclusive evidence of satisfactory results than would justify their employment at this time. As stated above, it is our opinion that when it becomes a matter of choice between palliation and operation we should decide in favor of prostatectomy. The surgeon is, however, infrequently called upon to decide this question, for prostatics as a rule are sent for surgical consultation on account of complications arising in the course of catheter life. In these cases the necessity of operative relief is generally self-apparent, but in no other surgical condition must we exercise greater surgical care in selecting the proper time for intervention and the best method of procedure.

There are no immediate indications for prostatectomy. In a limited number of cases where attempts at catheterization fail, or where, with complete obstruction, instrumentation produces excessive pain or hæmorrhage, and in a very few instances of bladder infection so severe that catheter drainage would be obviously inadequate, we must institute drainage, preferably by suprapubic cystostomy. To recapitulate — in all cases of acute or chronic retention, impossible to catheterize, in the presence of severe cystitis, and in all cases in which for any reason it is impossible to form a fair estimate of renal function, we must limit ourselves to the drainage operation, reserving prostatectomy for future consideration. Tapping of the bladder is a rarely useful method of temporizing. The mortality of prostatectomy performed on individuals in good health and with sound hearts and kidneys is practically nil, regardless of age. The majority of prostatics, however, possess neither good general health nor normal cardio-renal systems, and it may be stated as an axiom that the success of all prostatic surgery is in direct ratio to the recognition by the individual operator of the maximum capacity of these organs. The cases when first seen by the surgeon show a condition of functional activity of the vital organs approaching nearer to the minimal than to the maximal point of efficiency. The patient has been, perhaps for many weeks, harassed with the pain of frequent catheterization, or with frequent urination in the presence of an overdistended bladder and his vitality practically exhausted with the interrupted rest of nocturnal frequency. Toxins reabsorbed from the inflamed bladder, and often from a torpid bowel, have added an eliminative task to the kidneys already overburdened with metabolic waste products. Every hygienic detail of a prostatic's life is self-arranged to minimize his vesical comfort

and these efforts react injuriously on the kidneys. An estimation of the capacity of these organs to bear the weight of anæsthesia and operation at this time must be obviously misleading. Place these patients in bed with constant catheter drainage, encourage the ingestion of large amounts of water, clear the intestinal tract with mild purgatives, and after a night or two of rest and comfort the picture of impending uremia will have disappeared and the quantity and quality of the urine reveal a surprisingly good degree of reserve kidney function. It follows that the preoperative treatment is of greater importance than is the operation itself, granting adequate skill on the part of the operator. Of the various methods employed to estimate the working capacity of the kidneys, I attach most importance to quantitive and qualitative study of the urine. We need have little apprehension of uræmia after prostatectomy in an individual whose kidneys secrete a normal amount of normal urine for forty-eight hours preceding the operation. The subjects for this operation usually have some impairment of their kidneys independent of any obstructive cause in the lower urinary tract, and it is my invariable custom, in the absence of the complications spoken of above, to insert an indwelling catheter and carefully study the urine from day to day until it reaches a level of maximum in quantity and quality.

After trial of the various kidney functional tests that would bring the estimation of the elimination of the urinary solids to the point of mathematical exactitude, I am of the opinion that they have no practical advantage over the study of the chemical and physical characteristics of the urine. Of all measures directed to a diminution of the mortality of prostatectomy, that which has proven most valuable in our hands is the indwelling catheter by its aid in the restitution of kidney function. When the patient's condition has been improved to a degree warranting operation, the next question that confronts us is the selection of the method best suited for the particular case at hand.

This has been simplified to an extent by the general adoption of radical prostatectomy, with discard of the Bottini operation and its various modifications, together with those misdirected operations performed on the related sexual organs. The question therefore resolves itself into a choice between the suprapubic and perineal routes of prostatectomy. Our advocacy of the suprapubic route is tempered with the principles already laid down, that successful prostatic surgery depends upon one's ability to recognize the types best suited for, and the skill to perform, either operation. To recapitulate: where the prostate is without doubt malignant, tubercular, or the *seat of incurable gonorrhœa* (a rare indication), and in cases of benign scirrhus enlargement, in all of which conditions the gland is nonenucleable on account of nonencapsulation — difficult or impossible of access from above, with the normal capsule and sheath inseparably adherent and bound down to the surrounding levator-ani muscles and pelvic fascia, accompanied, as these conditions often are, by a bladder of small capacity and rigid walls, — in these cases, let me repeat, successful prostatectomy can only be performed by the perineal route. We follow the technique of conservative prostatectomy devised by Young, not with the idea of saving the ejaculatory ducts, but because, by the fine exposure afforded by this method, it is possible to remove the greater portion of the diseased gland under guidance of the eye and therefore with less danger to contiguous structures. With the exceptions cited above, the suprapubic route is preferable because:

1. The approach to the prostate is simple and practically bloodless.

2. The enucleation of adenomatous growths is accomplished with ease.

3. The working field is large and under perfect control.

4. The prostate is accessible and can be made more so by digital pressure on its rectal surface and without the danger of injury to the bladder liable with the use of the tractors necessary in the perineal operation.

5. The muscular control of the bladder neck is not disturbed since the internal vesical sphincter lies outside the line of cleavage, and incontinence is therefore less frequent following this technique.

6. Permanent fistulæ are less frequent after the suprapubic operation.

7. Sepsis occurs less than half as often as with the perineal operation.

8. Drainage is more nearly perfect.

9. Stones can be more easily removed.

10. Uræmia is a less frequent sequel.

11. The mortality is, in properly selected cases, no greater and the percentage of permanent cures much larger.

12. Immediate post-operative complications, especially hæmorrhage, are less often noted.

13. Sexual potency is maintained as frequently after the suprapubic operation as after the perineal, and the question of sterility is rarely of any consequence.

From this array of facts, it would seem that the perineal operation had no foundation as a routine procedure for the relief of benign prostatic hypertrophy. This is exactly my view of the matter.

In the absence of decided contra-indications, ether retains its place as the anæsthetic of choice. The subjects for prostatectomy usually have lesions of the cardiac, arterial, renal or pulmonary systems, so that the substitution of a drug ordinarily more dangerous than ether becomes a matter of considerable concern. Probably the safest, and, when properly administered, most satisfactory, substitute for ether is nitrous oxide-oxygen anæsthesia. In the presence of cardiac and arterial disease I believe ether to be a safer anæsthetic than nitrous oxide gas. Our choice of anæsthesia in the presence of pulmonary and renal lesions lies between chloroform, intraspinal stovain and nitrous oxide-oxygen. The field of usefulness of chloroform has been decidedly narrowed by the perfection of the nitrous oxide and intraspinal methods. Stovain gives satisfactory analgesia of the pelvis and lower abdomen in small dosage, and with less danger than attends its use in upper abdominal and thoracic work. In cases complicated by renal and pulmonary lesions it is the safest method to employ. This drug must not be used when there is any evidence of central disease of the respiratory system, nor in grave cardiac lesions. Its solution must be of lower specific gravity than that of the spinal fluid lest it rise to the vital centers when the patient is placed in the Trendelenburg or lithotomy postures. Furthermore, with the use of stovain, the cerebral centers are spared the depressing effects of peripheral traumatic impression and therefore less shock follows in patients of unstable mental constitution than in the use of any other anæsthetic. This multiplicity of methods of anæsthesia meets the demands of a variety of clinical conditions rather than denotes a general dissatisfaction with all methods, and we are fortunate in having a number from which the one best suited to any particular case can be chosen. The primary incision is made with the patient in the Trendelenburg position. This position with water distention of the bladder makes the organ accessible and removes the danger of opening into the peritoneal cavity.

The incision in the bladder wall should be placed high enough so that with the bladder empty it will approach as nearly as possible a right angle with the sagittal plane of the body. This affords better drainage and minimizes the danger of permanent fistula — a likely one with an oblique tract when the opening is made near the bladder neck. The incision through the vesical mucosa overlying the tumor is made near the internal vesical orifice and continued in a circular fashion around this opening. In this manner the mucosa is not torn radially during the enucleation process. The prostatic urethra is inseparable in the great majority of cases from the prostatic tumor and this circular incision removes the necessity of tearing it away at the upper portion of its vesical junction and I believe adds to the ease of enucleation. This method likewise eliminates the danger of urethral obstruction by a tab of mucous membrane projecting into the canal from the ragged edge of a bladder mucosa that has been torn from the prostatic urethra. Complete obstruction from this cause necessitated reoperation in one of my early cases. This experience led me to employ the circular incision, and since the adoption of this method, I have not met with a post-operative obstruction of this character. Prostatic tumors are usually adherent to

the triangular ligament, and along the anterior borders, by virtue of the pubo-prostatic ligaments, to the pubes, for it will be remembered that the normal stroma and sheath fuse at these points. These adhesions as a rule offer little difficulty to enucleation but in the event of marked density they can be easily separated with blunt-pointed scissors. Counter pressure on the rectal surface of the prostate assists in its enucleation by fixing the organ, and in its service as a guide to the enucleating finger.

As regards hæmorrhage, this is usually insignificant in amount and easily controlled with hot irrigations, but in the event of excessive bleeding, the prostatic cavity must be packed with gauze. Before introducing the gauze into the prostatic bed carry a continuous catgut suture through the upper margin of the lateral walls of the cavity, the free ends of the suture to be tied tightly after the gauze has been introduced. The free ends of the gauze project through the incision in the abdominal wall.

The drainage tube should be of large caliber, at least one half inch in diameter, and so placed that the siphonage of the bas-fond is proven perfect before the patient leaves the table, and held in this position by a single suture to the margins of the skin incision. This tube must have lateral and terminal openings to lessen the danger of its obstruction by a fold of mucous membrane. Catheters per urethram do not aid materially in the drainage and are liable to cause hæmorrhage in their removal. I rarely use them. In exposing the bladder a point of much practical importance is incision of the prevesical fat rather than tearing through this structure. The severed radicles of the pubo-prostatic venous plexus can be ligated immediately and very little oozing follows, as compared with that seen when the fatty tissue is torn. Incision permits of perfect drainage of a single space with a piece of selvedge gauze or rubber dam, an obvious impossibility when multiple cavities are present after tearing through this structure. It follows that sepsis from prevesical infection rarely complicates the operation when this technique is employed. As a final step in the operation, the bladder wall is anchored to the rectus muscle with a suture of catgut and the incision, if rather large, is closed in its lower end and the drainage tube and gauze from the bladder and prevesical space brought out through the upper angle. In the absence of shock which sometimes demands active treatment, the important post-operative possibilities are, in their order of frequency, uræmia, pneumonia, hæmorrhage and sepsis. Immediately on the patient's return to his bed, a subcutaneous injection of 500 to 1000 cc. of normal saline solution is given and the routine post-operative procedures instituted. Venous oozing invariably occurs but rarely in sufficient quantity to give concern.

In the event of excessive bleeding after operation, simple measures such as irrigation with hot water through the drainage tube may be tried, but it is best not to temporize as these patients bear the loss of blood very poorly. If the hæmorrhage is not checked by these simple measures, the patient must be anæsthetized, the wound opened and gauze packed into the prostatic bed until the bleeding is under control. This radical step is rarely necessary in cases properly selected for the suprapubic operation. Sepsis is a rare sequel of suprapubic enucleation and it is well to remember that an irregular temperature is often seen in those cases in which gauze packing has been used. This gives an entirely different picture than a progressive septic condition and the temperature immediately subsides when the gauze is removed. Sepsis from pelvic cellulitis is usually a fatal complication but its relief is to be attempted by appropriate drainage. As a routine measure, the bladder is washed out daily with permanganate of potash or other weak antiseptic solution. The patient is given urotropine and encouraged to drink large quantities of water. Uræmia and suppression of urine occur at times in spite of careful selection of cases and judicious treatment both before and after operation. Hiccoughing and nausea are the danger signals. Their occurrence demands frequent gastric lavage followed by the introduction of large doses of magnesia sulphate solution until the bowels are freely open. Absolutely nothing is to

be given by mouth. Hyperdermoclysis, 1000 cc. of normal salt solution, is given every six or eight hours. Continuous proctoclysis is instituted and caffeine and sparteine hypodermically, with nitroglycerine or not, depending upon the tension of the pulse. The condition is sometimes fatal but energetic treatment along these lines will sometimes save an apparently hopeless case.

Gauze is removed in from three to five days and the drainage tube comes away within a week. A smaller tube may be substituted or one of the various cups used to keep the patient's body dry while the fistula is in the process of healing. If gauze has been placed in the prostatic bed to control hæmorrhage, after its removal the bladder should be washed out through the urethra by simply engaging the nozzle of an irrigation tube in the meatus. If the latter cannot be done, which is seldom the case, a soft rubber or English catheter is introduced through the urethra and the washing done through this. The patient is gotten out of bed as soon as possible. This can be safely advised when the gauze is out and the danger of secondary bleeding therefore remote. Small quantities of urine are often passed within the first ten days and this function completely restored with closure of the sinus in a period of from four to six weeks. Instruments should not be passed per urethram unless the restoration of the urinary function is retarded with signs suggestive of an obstructive cause to explain it. Before discharging the patient a sound should be passed to the bladder, but in the absence of any difficulty in its introduction, this need not be repreated, at least for several months. It is evident that the treatment varies in different cases, but with the proper selection of cases for prostatectomy and with the selection of the proper operation for the individual case, attention to the simple details as outlined above will suffice to help the patients to a speedy and complete recovery. The mortality of prostatic surgery is dependent upon the choice of anæsthesia and its skilled administration, proper selection of cases, which presupposes careful pre-operative study, and upon the exercise of care in the after-treatment. Unfortunate sequels are eliminated in our determination of the proper method of operation and its skillful performance, so that success, however frequent, cannot lighten the burden of our responsibilities, for operative mortality and morbidity in prostatic disease are merely superstructures invariably built on a foundation of poor surgical judgment.

REGENERATION OF BONE FROM PERIOSTEUM

By S. L. HAAS, M. D., San Francisco
From the Pathological Laboratory of Stanford University Medical Department

WITH the development of bone surgery has arisen the question of the importance of the periosteum in bone regeneration and repair. Clinical and experimental observation has failed to show whether the regenerative processes have their origin in the periosteum or in the cells of the bone itself.

Much has been learned from the careful study of the changes which occur in transplantation of bone and periosteum, but wide differences of opinion have arisen as to the relative importance of the bone and the periosteum in initiating the regenerative processes.

It is impossible to review the extensive literature on this subject; only a brief summary of a few of the publications can be given.

Foremost among the earlier investigators along this line is Ollier, to whom we must give especial credit for his accurate observations, which only recently have received their just recognition. He maintained that all the transplanted bone including the periosteum

remained alive, admitting, however, that there was some absorption of the old bone. He ascribed to the cells of the marrow, Haversian canals, and osteoblastic layer of the periosteum, especial importance in regeneration; and gave preference to living bone which was covered with periosteum for transplantation.

Among the later investigators we find a considerable difference of opinion.

Barth from his experiments arrived at conclusions which were directly opposed to those of Ollier. He claimed that all transplanted bone, whether with or without periosteum, died; and that regeneration took place from the surrounding bone.

Frangenheim found that while the greater part of the bone became necrotic, a certain number of the bone cells remained alive. He recognized the influence of periosteum in producing bone, but ascribed to it a relatively insignificant part in the process.

Macewen found that pieces of bone without periosteum, when transplanted into muscle, showed definite signs of proliferation.

Murphy believes that there is always complete absorption of periosteum-free bone when it is transplanted into tissue in which there is no bony surrounding; but he gives no experimental evidence to substantiate this idea.

Baschkirzew and Petrow present an interesting explanation regarding the regeneration of bone when transplanted into muscle. They believe that the majority of bone corpuscles die, and that only those which receive better nutrition and possess especial vitality remain alive. The presence of periosteum or marrow is not considered necessary for regeneration, even though large pieces of bone be transplanted. They believe the chief source of regeneration to be a proliferation of the surrounding young connective tissue elements of the muscle, which penetrate into the vascular spaces and canals of the bone, where, through a process of metaplasia, they acquire the properties of osteoblasts and regenerate the new bone. They called attention to the fact that Ollier had also suggested such a possibility in his earlier work. In clinical applications the periosteum is admitted to be of value, not for its property of regeneration of bone, but because it aids in directing bone growth, and serves as a protecting membrane for the new bone. The periosteum is also said to produce new bone, which, however, is soon absorbed.

Lubenhoffer from his work concludes that transplanted bone dies off but the periosteum remains alive.

A discussion of these various theories can not be entered into, but Axhausen's conclusions will be given as they seem to sum up the generally accepted ideas. He says that some of the bone dies, but that part of it remains alive; that the periosteum and marrow remain alive and produce new bone; that when bone is transplanted into a bony bed it makes no difference whether the transplanted bone be living or dead, or whether it be covered with periosteum, but that there is greater probability of successful regeneration if it is alive and covered with periosteum. He also mentions the value of making longitudinal incisions in the periosteum.

From the transplantation experiments in which both periosteum and bone are used, one can not draw any definite conclusions in regard to the regenerating power of the periosteum alone. Some of the earlier experimenters report that pieces of periosteum transplanted by themselves have the ability to produce bone; others report opposite results.

Amongst the more recent work is that of Trinci, who found that in free periosteal transplantation in rabbits and dogs, bone was formed from the periosteum. He refers to similar results obtained by Bonomme.

Macewen says that the periosteum when transplanted does not produce bone, except in cases where there was an abnormal stimulus before it was removed, or where small pieces of bone were removed with the periosteum. One might infer from his writings that the periosteum of growing animals may have osteogenic properties.

Carrel has cultivated periosteum on his special media and has found that when this growing periosteum is transplanted into subcutaneous tissue, it leads to bone formation.

Murphy mentions in a recent article that periosteum from a young individual, when

transplanted into a fat or muscle tissue bed in the same individual, may produce a lasting bone deposit. No experimental proof is given.

The consensus of opinion of these observers seems to be that the transplantation of pieces of periosteum may result in the formation of new bone, especially if the animal is young.

Other investigators have made use of very fine pieces, or of an emulsion of periosteum for transplantation. Pochhammer scraped off the "cambium" layer of the periosteum and transplanted it into muscle with negative results; but when he transplanted teased pieces of the entire periosteum, bone was formed in 15 per cent of the cases. In another series of experiments he first scraped off the "cambium" layer of the periosteum and then the outer surface of the bone; a mixture of the two was transplanted into muscle and small nodules of bone were formed in 10 to 14 days. He refers to the experiments of Berthiers in which were found bone formation following transplantation of pieces of periosteum into muscle.

Attention must be called to the recent work of T. Jokoi who used an emulsion of periosteum, which he injected either subcutaneously or intramuscularly. He found that six out of ten experiments on rabbits showed active bone formation following autoplastic transplantation, and that even after seventy days there was a tendency to proliferation. In homoplastic transplantation there was active growth while in heteroplastic cases negative findings were the rule. If fresh blood was injected with the emulsion there was no increase in bone formation, but if fibrin was used active increase of bone development resulted. If he injected the cambium layer of the periosteum alone there was no bone formation, and even if there were also small particles of bone these underwent resorption. Reference is made to a previous and similar work by Nakahara and Dilger.

Bergel has also emphasized the importance of fibrin in stimulating the production of callus.

Many authors have used pedicled flaps instead of free transplantation, in order to obtain additional evidence of the power of periosteum to form new bone.

Pochhammer stripped almost the entire periosteum from the humerus of rabbits, allowing it to remain attached to the bone at the lower end of the shaft. He then arranged the periosteum into the form of a tube which he filled with muscle. He found a small amount of new bone only at the lower end of the tube where the periosteum remained attached to the shaft of the humerus. He then filled the periosteal tube with blood clot instead of muscle, and found a considerable increase in the amount of bone formation. These experiments give no absolute proof as regards the regenerative property of periosteum, but they show the marked stimulating effect which blood clot exerts on the growth of bone.

Trinci in his experiments excised ½ to 1 cm. of the shaft of the fibula of dogs. He bridged this gap with periosteal flaps which were turned down from the remaining bone stumps. In the microscopical preparations of the early cases he found new formation of bone in the center of the gap, where its only possible source was periosteum; and in late cases there was evidence of union between this central new formed bone and that which had developed at the ends of the shaft. He also emphasizes the importance of blood clot and bone particles as a stimulating material for bone formation from the lower layers of the periosteum, and states that there is less active growth of bone if these substances are lacking. The details of his experiments are not clear, nor are they free from criticism.

Macewen raised a strip of periosteum from the radius of a dog, leaving it attached to the epiphysis in one case, and to the shaft in the other. He carried these strips between the fasciculi of the adjacent muscle and reattached the free end to the cut edge of the periosteum on the shaft. In eight days he found no new formation of bone from the raised periosteum.

Murphy cites cases in which he turned out similar flaps and found new formation of bone on the under surface of the periosteum.

Finally, attention must again be called to the work of Macewen, the summary of which

appears in his recent book on "The Growth of Bone." The majority of his experiments are planned to show the "osteogenic potency of the growing shaft," and comparatively few of them refer directly to the influence of periosteum on the regeneration of bone. Granting that he has shown that "diaphyseal bone may be reproduced by proliferation of osteoblasts derived from pre-existing osseous tissue," and that the periosteum is not essential to bone production, nevertheless he does not conclusively prove that the periosteum may not also reproduce bone. He has minimized the importance of the periosteum in too great a degree when he says it acts merely as "a limiting and protecting membrane and has no osteogenic function." [1]

A further discussion of the views of the various authors would not help in the solution of this problem. One is forcibly impressed with the variable results of the different observers, working under conditions which appear to be similar. It is possible that further, repeated, and more exact study will unify the findings.

In order to emphasize the complex system of bone formation and development, a few important anatomical and embryological facts must be mentioned.

Like other connective tissues, bone is formed from a blastemal syncytium, the ground substance of which is composed of white fibrous tissue. Development may take place in two ways from this primary ground substance; in one case it is directly transformed into bone, in the other it passes first through a cartilaginous stage. The two methods are designated intra-membranous and intra-cartilaginous respectively. In both methods the "osteoblasts" play an important part; arising in one case by direct transformation from the ground cells, in the other from the perichondrium. In studying the development of intra-cartilaginous bone formation, one can not neglect the important rôle of the perichondrium and periosteum. The embryological development of the marrow cavity, of the Haversian canals, and of the Volkman's canals are all dependent upon this surrounding membrane; and it does not seem probable that so important a structure in embryological development should become inert when there is later call for bone formation.

Even in the normal development of bone we find a considerable dispute as to the exact origin of its various elements. It is not surprising, therefore, that controversy should arise as to the method of regeneration of bone.

Before proceeding with the description of these experiments a brief definition of the periosteum, both as it is usually described and as it is considered in the following experiments must be mentioned.

Periosteum is made up of three layers:

1. Outer fibrous layer possessing blood vessels.

2. Inner fibrous elastic layer, made up of a network of elastic fibers and containing lymph spaces.

3. Osteogenetic layer, which is more marked in the young bone, consisting of delicate bundles of fibrous tissue and a large number of embryonal connective tissue cells; namely, osteoblasts. After growth has ceased the osteoblastic layer becomes reduced to an inconspicuous stratum included with the inner fibrous layer. The osteogenetic layer is rich in blood vessels which are continuous with the marrow during development. Nerves are also present.

Macewen emphasizes the importance of the loose areolar tissue beneath the periosteum.

In the following experiments the periosteum is considered as that membrane which remains after a careful subperiosteal resection of the underlying bone, especial care being exercised that no bone elements be left behind. This is what is usually understood by the surgeon as periosteum.

These experiments were undertaken in order to furnish evidence either for or against the osteogenetic regenerative power of the periosteum. The deductions in the main are based upon the macroscopical findings. In cases where doubt existed as to the nature of the tissue, microscopic examination was made.

The rib was selected for the sake of convenience, as it was not necessary to use

[1] Macewen takes special care to prevent hæmorrhage into the field of operation. In view of the influence of blood-clot in stimulating bone growth, it would be interesting to see what effect its presence would have on his experimental results.

splints, and because several experiments could be carried on at the same time on the same animal. Criticism might be made because of the constant motion of the chest wall, but this was not excessive, even where two ribs were removed, because an intervening normal rib was allowed to remain intact.

The series consisted of forty rabbits, two dogs, and two cats, on which sixty-two observations were made. The exact age of the animals could not be determined although the majority of them were young, growing animals. The experiments varied in duration from 4 to 249 days, and extended over a period of two years.

Method: Under ether anæsthesia the skin was shaved and painted with tincture of iodine. Incision was made through the skin over the selected ribs to the subcutaneous tissues. In case blood clot was to be used in the experiment, the blood was collected into a sterile tube from the superficial vessels. Incision was next made through the muscles to expose the ribs, the latter being treated according to the demands of the experiment. The severed muscles were restored and the skin closed with silk sutures. The animal was allowed its freedom on recovery from the anæsthetic.

The only difficulty experienced was the prevention of a pneumothorax, especially in the rabbits where the periosteum and costal pleura form practically a single thin membrane. Pneumothorax in rabbits often proves rapidly fatal.

The periosteum strips easily from the ribs, excepting in the region of the angle, at which place the muscle fibers are attached directly to the bone, and at the chondrocostal junction, where the periosteum and perichondrium are found somewhat adherent to the cortex of the bone.

The experiments are arranged into groups according to the method of procedure. In cases where two ribs were operated upon at the same time they will be described separately according to the respective method to which they belong. By reference to the accompanying diagrams it will be seen that there are 19 groups of experiments, in which the following methods are presented:

1. Simple subperiosteal resection.
2. Simple subperiosteal resection in which a small island of bone is allowed to remain in the periosteal gutter.
3. Simple subperiosteal resection of rib, remaining ends of which are covered with lead caps.
4. Elevation of rib from periosteal bed, from which it is separated by interposed muscle.
5. Same as (4) with addition of blood clot in the periosteal gutter.
6. Extensive subperiosteal resection of rib including costal cartilage, with addition of blood clot to center of periosteal gutter.
7. Same as (6) excepting that the sternal side is blocked off with paraffin.
8. Same as (6) excepting that both sternal and vertebral sides are blocked off with paraffin.
9. Subperiosteal resection with paraffin at both ends, the interval between remaining empty.
10. Elevation of and removal of a section of the rib, the free ends being placed inside of a rubber tube.

Method[1] 1. Simple subperiosteal resection.

These experiments were performed in order to illustrate the method of regeneration following an ordinary resection.

Results: R 52 A, Gr. XVII, after 15 days showed regeneration at both vertebral and costal cartilage stumps, but not complete filling of the periosteal gutter.

R 1, Gr. I, after 20 days showed the entire periosteal gutter filled with cartilage with a small island of bone at one place.

R 50 A, Gr. XV, after 45 days, and R 15″, Gr. I, after 124 days showed complete regeneration of the rib.

C 3 B, Gr. XVIII, showed almost complete regeneration after 47 days.

Deductions: The variability in the findings in R 52 A and R 1 suggest that the regeneration of bone may take place in two ways: (1) development of cartilage preceding formation of bone; (2) direct formation of bone. It is definite that these experiments do not show whether the new bone arises from the

[1] In the description of the experiments, the rabbit experiments are labeled R, the cat experiments C, and the dog experiments D. A and B designate which rib is described and Gr. the group to which it belongs.

periosteum or from the remaining bone stumps.

Method 2. Simple subperiosteal resection in which a small island of bone is allowed to remain in the subperiosteal space.

Results: In R 7, 3 and 8 of Gr. III there was a small amount of regeneration from the bone ends and about the islands after 12, 46, and 48 days respectively. In R 54, Gr. XIX, after 14 days there was a considerable amount of new bone formed about the island, and a limited amount about the severed ends.

Deductions: In three instances in which large bone pieces were left behind the amount of regeneration was very limited, and only in one case was the regeneration marked. In view of the osteogenetic property which is ascribed to bone it is surprising that in these experiments there was so limited a new formation of bone.

Method 3. Simple subperiosteal resection of rib, the remaining ends of which are covered with lead caps.

Lead caps were placed on the severed bone ends in order to prevent the ingrowth of bone from the sides.

Results: In two experiments of this nature, in R 4 and R 8 of Gr. IV, after 11 and 210 days respectively, the periosteal space was found free from bone growth excepting for a small amount of bone which formed beneath the cap at the sternal side.

Deduction: The periosteum alone did not regenerate bone.

Method 4. Elevation of rib from periosteal bed from which it is separated by interposed muscle.

The periosteum was separated from the rib from about the costal cartilage to the angle. The intact rib was raised from its periosteal bed and the cut margins of the periosteum were sutured together. It was thought that by this method the periosteum could be isolated, and that growth of bone from the rib could be prevented. It was also thought that there would be less tendency to post-operative hæmorrhage.

Results: As is shown in the diagrams under Gr. V and B of Gr. IX, bone always grew in from the junction of the raised rib and the periosteum. In general the amount of growth was dependent upon the duration of the experiment. In only one case, R 12, Gr. V, after 26 days, was an isolated island of bone found in the periosteal gutter. In R 14 A, Gr. VII, after 4 days, the periosteal gutter was found to be filled with blood clot, thus showing that post-operative hæmorrhage did occur in at least some of the cases.

Deductions: It is evident that in these experiments new bone was not formed from the periosteum alone. The regeneration of bone occurred always from the point where the bone and periosteum diverged, and in general the amount of regeneration was directly proportional to the duration of the experiment. One apparent exception is noticed in R 13, Gr. V, in which after 249 days there was only a small amount of new bone; but this animal was old and had been used in a previous experiment.

Method 5. Elevation of rib from the periosteal bed from which it is separated by interposed muscle. Blood clot was placed in periosteal space.

Results: The four experiments of Gr. VIII and one of Gr. IX (R 25 A) show that there is a marked increase in the amount of new bone formed when blood clot is placed in the periosteal gutter. In almost every case, even within 16 days, the periosteal gutter was completely filled with new bone.

Deductions: No doubt can exist that there is marked increase of bone production in the presence of blood clot. Whether this is due to the increased regeneration from the ends, to the increased periosteal production, or to both, remains to be proven.

Method 6. Extensive subperiosteal resection of rib including part of costal cartilage, and the addition of blood-clot to the center of subperiosteal space.

Results: In R 32 and R 30 of Gr. XI, and in R 52 B, Gr. XVII in 13, 24, and 15 days respectively, it was found that the new-formed bone was in close proximity to the costal cartilage.

Deductions: It is possible that the new bone may have formed in the region of the blood-clot, and that subsequently it may have extended toward the costal cartilage, but this could not be definitely established.

Method 7. Extensive subperiosteal resection of rib including costal cartilage, with addition of blood-clot to center of periosteal space and of paraffin at the sternal side.

It was thought that by blocking off the

Plate 1.

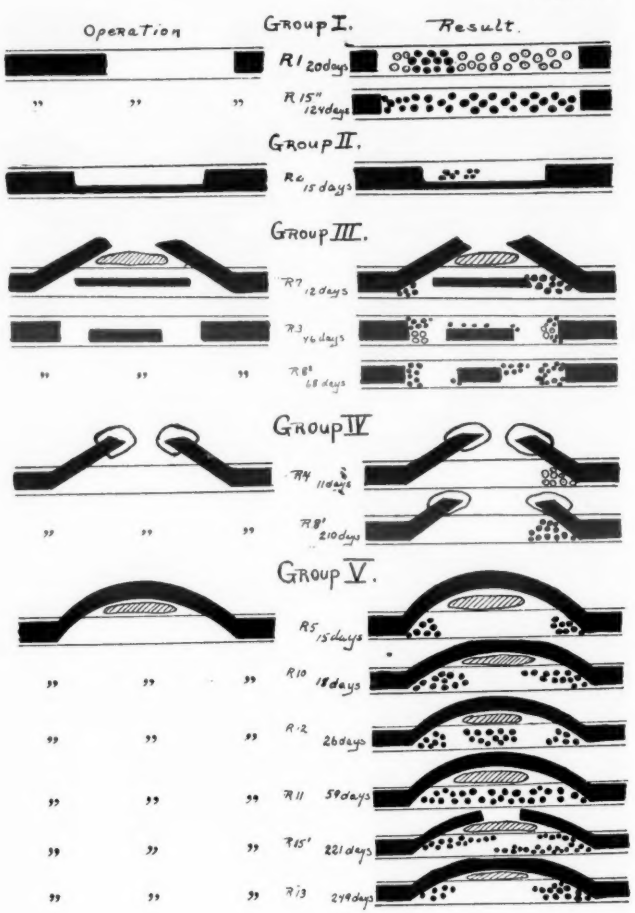
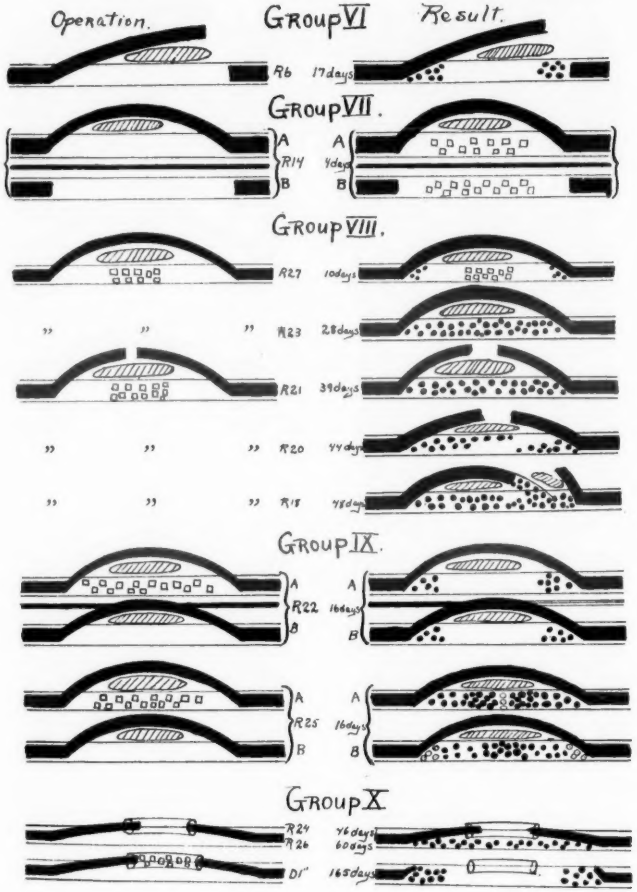


Plate 2.



growth of the bone from the sternal side definite evidence could be obtained as to the regenerative power of the periosteum. In order to accomplish this separation, hot paraffin was placed between the blood-clot and the costal cartilage.

Results: In R 33, Gr. XII, the new-formed bone was directly continuous with the vertebral stump of the rib. It became evident that the paraffin must be placed at both ends of the periosteal gutter.

Method 8. Extensive subperiosteal resection of rib, including part of costal cartilage, with the addition of blood-clot to the center of the periosteal space and of paraffin at both sternal and vertebral sides.

Results: In R 38, 35, 39, 42, and D 2′ of Gr. XIII, D 2″ B, C 1′ B, and C 1″ B of Gr. XVI, and C 3 A, Gr. XVIII, isolated islands of bone were found in the periosteal gutter. These were entirely free from any bony connections with either of the severed ends of the ribs. In R 54 A, Gr. XIX, R 44, Gr. XIII, R 50 C, Gr. XV, R 46 A and R 48 B of Gr. XVI, also newly formed bone was found in the center of the gutter, but in these cases the central bone was connected by narrow bridges of bone with the stumps of one or of both sides.

Deductions: In this group there are nine cases: four in rabbits, three in cats, and two in dogs, where there are definite islands of new bone which are entirely free from any connection with the stumps of the ribs; and six cases in rabbits where the greater part of the new bone occupies a corresponding position, but is not definitely separated from the bone at the ends. From the first nine cases there is conclusive evidence that periosteum in the presence of blood-clot has the power of regenerating bone. In the last six cases, because of the bridges at the ends, there is a possibility that the new bone has arisen from the stumps of the rib. But in view of the fact that the central portion of the bone was denser and appeared older than the bone of the connecting bridges, and since in a greater number of cases the islands of bone were entirely free, it would seem probable that the new bone originated in the center of the periosteal gutter and that the bridges of bone to the stump of the ribs were of secondary development. And this seems all the more probable because in every case excepting one where connection with pre-existing bone had been established, the duration of the experiment was greater than where free islands of bone were found.

Method 9. Subperiosteal resection of a rib with paraffin at both ends, the interval between remaining empty.

These experiments were used as controls.

Results: In D 2″ A, C 1′ A, D 1′ B, and R 46 B of Gr. XVI, and R 40 Gr. XIV, there was no growth in the center of the periosteal gap, the only new bone being in the region of the bone stumps. In R 50 B, Gr. XV, R 48 A. Gr. XVI, new bone was present, but was in direct connection with pre-existing bone. In R 41, Gr. XIV and C 1″, Gr. XVI, islands of bone were formed just as in cases where blood-clot was used.

Deductions: Here we have five definite cases which, in the absence of blood-clot, showed no evidence of regeneration of bone. There were, however, two cases in which newly formed bone was found in the gap but was connected with one or both stumps; and two in which there were isolated islands of bone exactly similar to those which were found when blood-clot had been placed in the periosteal gutter. The explanation of these last four cases is not clear. It is possible that the long duration of the experiments in the

EXPLANATION OF PLATES

Column I indicates the method of operation.
Column II indicates the result.

indicates that two ribs were operated upon at the same time.

indicates normal bone.

indicates regenerated bone.

indicates normal cartilage.

indicates regenerated cartilage.

indicates periosteum.

indicates blood-clot.

indicates paraffin.

indicates muscle.

Plate 3

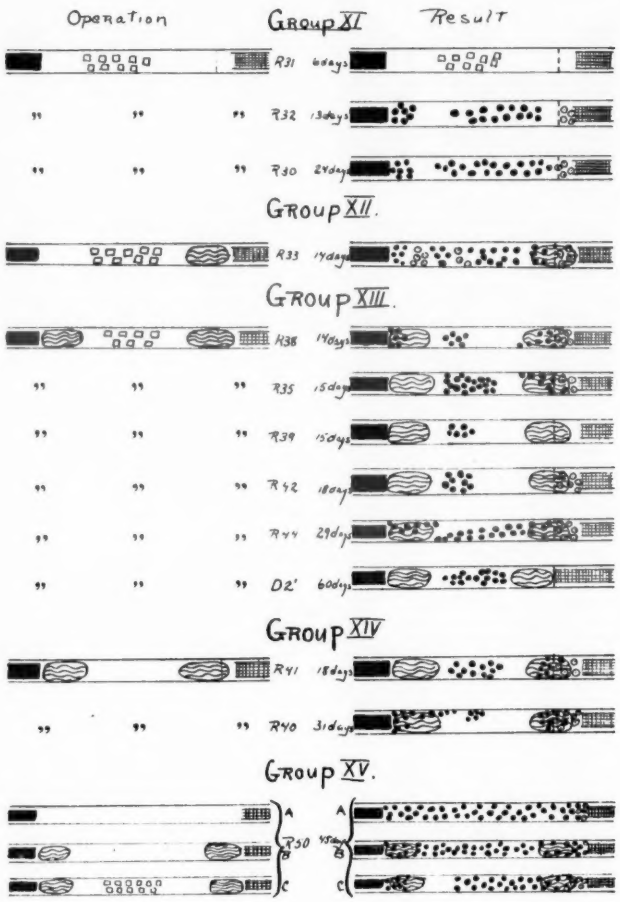
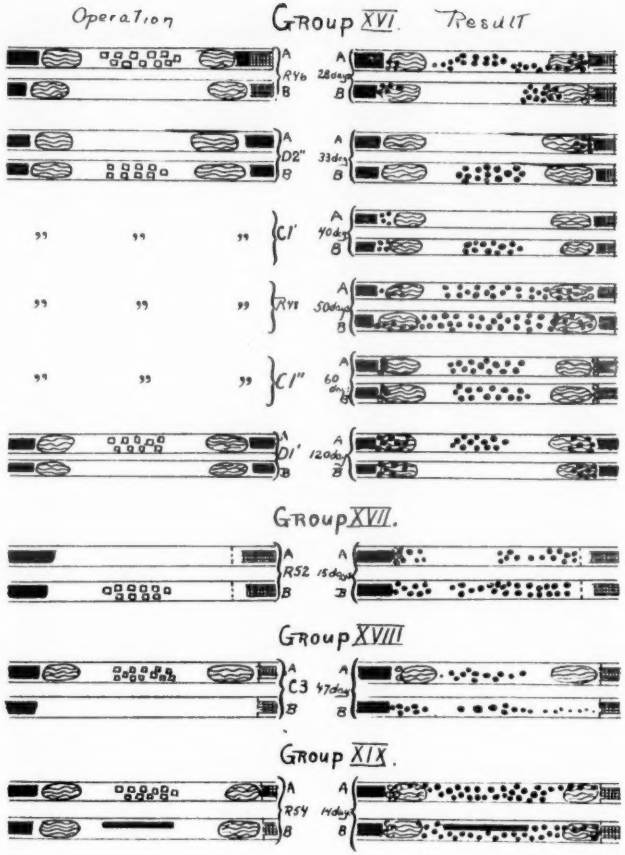


Plate 4.



two former may have given time for extension of growth from the stumps, but in the other two one can only explain the results by assuming that post-operative hæmorrhage had occurred.

These experiments show that in five of the nine experiments where blood-clot was not placed in the periosteal gutter, there was no proliferation of new bone, whereas of the ten cases described under Method 8 where blood-clot was added, nine showed definite new formation of bone. It would therefore appear that the presence of blood-clot must supply some stimulus to the periosteum which leads to active bone regeneration.

Method 10. Elevation and removal of a section of the rib, the free ends being placed inside of a rubber tube.

These experiments were performed to determine whether bone which has been freed from periosteum retains its power of regeneration.

Results: In R 24, R 26, and D 1″ of Gr. X, after 46, 60 and 165 days respectively, no evidence of new bone was found within the tube; on the contrary, there was definite evidence of necrosis of the enclosed bone.

Deductions: Although these experiments are not exactly analogous to Macewen's glass tube experiments, one would not expect such discordant results if all his assumptions as to the osteogenetic power of bone itself are correct. It must be admitted that by placing the ends of the bone within the tubing, possible sources of nourishment may be destroyed.

COMPARATIVE RESULTS

In a number of experiments the several methods just described have been performed at the same time, under the same conditions, and on the same animals. The experiments have been arranged in the diagrams to bring out these details.

GENERAL DEDUCTIONS AND REMARKS

The most striking feature of the foregoing experiments is the influence of blood-clot in stimulating the formation of new bone. There can be little doubt that the blood-clot exerts some specific influence, since the presence of various other foreign substances has failed to stimulate bone regeneration. Pochhammer found that the addition of agar-agar, gelatine, and living muscle tissue did not cause any increase in bone regeneration, and in the above experiments the addition of paraffin caused no increase in bone formation. The importance of blood-clot in the regeneration of bone was recognized by Shede, who advised the addition of blood-clot after resections for osteomyelitis, and by Bier who has recently emphasized the advisability of allowing clots to form in places where new bone formation is desired.

Another interesting feature of these experiments was the absence of the regeneration of bone from pre-existing bone which had been separated from its periosteum.

In cases where the rib was isolated from its periosteal bed there was never any evidence of proliferation from the denuded bone. In fact, in the majority of cases the raised ribs became atrophic. In cases where the severed ends of the denuded ribs were inserted between muscle fasciculi there was never any evidence of regeneration, and where fractures were produced in the periosteum-free bone no evidence of union was found. These results are of considerable interest in view of the findings of Macewen, and further experiments are necessary to show whether the ribs differ from the long bones of the extremities in this respect.

The constant occurrence of new bone at the angle of separation between the elevated rib and the periosteum raises the question of the relative importance of periosteum and bone in the regenerative process. If one assumes that the newly formed bone arises from the pre-existing bone, one would expect that the new bone should extend along the raised rib as well as in the periosteal gutter. The experiments do not show this to be the case. Although the new bone was always formed at the angle between the rib and the periosteum, it extended only along the periosteal gutter. It can not be denied that the bone may have had some influence in originating the regenerative processes, but it is significant that the regeneration occurred only where periosteum was also present, and one can not but conclude that the periosteum must have acted in some

other way than by merely passively directing the distribution of new bone. It may be that the periosteum possesses some power, possibly of a chemotactic nature, which determines the direction in which the new bone shall grow, but from these experiments there seems little doubt that it also plays some important part in the actual regenerative process.

In several experiments where the chondrocostal junction was removed it was noted that new bone was formed near the site of the junction. In practically all cases there was also regeneration of cartilage, and in some cases the new cartilage and the new bone were continuous. In the cases where the new bone was separated from the cartilage it is difficult to explain its presence unless it arose from the periosteum. It is possible that the dependent position of this region when the animal is moving around may have caused the accumulation of blood-clot in this area, and that the combined action of the periosteum and blood-clot was responsible for the formation of the new bone.

CONCLUSIONS

1. That periosteum, especially in the presence of blood-clot, has the power to regenerate bone.

2. That regeneration of bone is not solely dependent upon the presence of pre-existing bone.

3. That regeneration of bone was never found excepting when periosteum was present.

(I wish to express my indebtedness to Professor Ophüls for the privilege of performing these experiments under his direction.)

Since this article was submitted the following contributions have appeared:

Schepelmann, E., Freie Periostverpflanzung, Experimentalle Untersuchungen. Arch. f. klin. Chir. 1913, ci, 499.

He finds that the periosteum when transplanted into the omentum, mesentery, spleen, liver, etc., regenerated persistent new bone and emphasizes the importance of vascularity, integrity of the cell, and use of entire periosteum.

Albee, F., An Experimental Study of Bone Growth, etc. J. Am. M. Ass., 1913, lx, 14, 1044.

He finds that the periosteum when transplanted into muscle did not regenerate new bone. He thinks that the outer layer of the cortex is necessary and agrees with Macewen in most respects.

LITERATURE

1. Axhausen. Die histologischen und klinischen Gesetze der freien Osteoplastik. Arch. f. klin. Chir., 1908–09, lxxxviii, 23.
2. Axhausen. Arbeiten aus dem Gebiet der Knochenpathologie und Knochenchirurgie. Arch. f. klin. Chir., 1911, xciv, 241.
3. Barth. Histologische Untersuchungen über Knochenplastic. Ziegler's Beitr., 1896, xvii.
4. Barth. Über Osteoplastik. Arch. f. klin. Chir., 1908, lxxxvi, 859.
5. Baschkirzew, Petrow. Beiträge zur freien Knochenüberpflanzung. Deutsche Ztschr. f. Chir., 1911–12, cxiii.
6. Bergel. Über Wirkungen des Fibrins. Deutsche med. Wchnschr., 1909, h. 15, 663; h. 31, 1349.
7. Bergel. Callus bildung durch Fibrin. Arch. f. klin. Chir., xciii, 755; xcv, 16.
8. Bier. Die Bedeutung des Blutergusses für die Heilung des Knochenbruchs. Med. Klin., 1905, i, 1–2.
9. Bier. Beobachten on Knochen Regeneration. Arch. f. klin. Chir., c, h. 1.
10. Bonome. Arch. delle Scienze mediche, ix, 9.
11. Carrel. Growth of Tissue. J. Am. M. Ass. 1912, lix, 525.
12. Frangenheim. Dauerfolge der Osteoplastik. Arch. f. klin. Chir., 1910, xciii, 195.
13. Haas. Regeneration of Bone from Periosteum. Proc. Soc. Exp. Biol. and Med., 1912, x, 57–58.
14. Jokoi. Exp. Beiträge zur Knochenneubildung durch Injektion bzw. Implantation von Periostemulsion. Deutsche Ztschr. f. Chir., 1912, cxviii, 433.
15. Lobenhoffer. Beiträge zur Lehre von der freien Osteoplastik. Beitr. z. klin. Chir., 1910, lxx, 87.
16. Macewen. Growth of Bone. 1912. Glasgow and Roy. Soc., Phil. Tr., Ser. b, cxcix, 253–279.
17. Macewen, Geddes. Growth of Bone, Normal and Abnormal. Brit. M. J., 1912, Sept. 28, No. 2700.
18. Murphy. Evolution of New Bone, etc. Ann. Surg., Phila., 1912, lvi, 344–347.
19. Murphy. Contributions to the Surgery of Bones. J. Am. M. Ass. 1912, lviii, 14, 985.
20. Nakahara, T. und Dilger. Subcutane und intramusculare Knochenneubildungen durch Injection bzw. Implantation vom Periostemulsion. Beitr. z. klin. Chir., 1909, lxiii, 235.
21. Ollier. Traité experimental et clinique de la regeneration des os. 1–11, 1867, Paris.
22. Ollier. De l'osteogenese chirurgical. Verhandlung des internat. med. Kongresse zu Berlin, 1890, iii, Abt. vii.
23. Pochhammer, C. Über d. Entstehung parostaler Callusbildungen, etc. Arch. f. klin. Chir., xciv, 1, 353.
24. Pochhammer, C. Bermerkungen zu dem Aufsatze des Herrn Dr. Bergel: Zur Callusbildung durch Fibrin. Arch. f. klin. Chir., xcv, 2, 22.
25. Trinci, Ugo. Exp. Beitrag zum Studium der Periostüberpflanzungen. Ztschr. f. orthop. chir., 1912,. xxx, 69.

A STUDY OF THE MECHANISM OF THE STOMACH AFTER GASTRO-ENTEROSTOMY BY MEANS OF THE X-RAY

By JOHN H. OUTLAND, M. D.
Surgeon to the Swedish Hospital, Kansas City, Missouri, and Bethany Hospital, Kansas City, Kansas
AND
E. H. SKINNER, M. D.
Röntgenologist to the Kansas City General Hospital, Swedish Hospital and St. Luke's Hospital, Kansas City, Missouri.
AND
LOGAN CLENDENING, M. D., Kansas City, Missouri

THE indications for the operation of gastro-enterostomy have become, within recent years, quite strictly defined. It has been repeatedly proved that in properly selected cases it results, in a majority of instances, in a symptomatic cure; in many other cases it affords great relief; and in cases of malignant stricture of the pylorus it affords a palliative relief that is very grateful.

A number of studies of the physiology and mechanism of digestion after gastro-enterostomy have been made. Cannon and Blake (1) did gastro-enterostomy and pyloroplasty on normal cats and studied the movements of bismuth meals with the X-ray at various intervals after recovery. They consider the results under four heads—drainage, vicious circles, kinks, and the intermixture of food and duodenal juices.

Drainage. They performed gastro-enterostomy on ten cats. They varied the size of the gastro-enterostomy opening and performed both posterior and anterior gastro-enterostomy. They point out that, on account of the position of the cat's trunk, anterior gastro-enterostomy is often more of a drainage operation than posterior gastro-enterostomy. After recovery the animals were fed bismuth meals of various consistencies, from water to canned salmon, and the emptying of the stomach studied with the X-ray, by means of the flouroscope.

They recorded that in most instances the meal left the stomach by the pyloric route. Sometimes it left by both routes, and the larger the stoma the more apt the meal was to leave by that route, but their general conclusions were that, in the presence of a patent pylorus, the food left through the pylorus rather than through the gastro-enterostomy stoma, no matter where placed or how large. They tied off the pylorus in two instances, realizing that clinically gastro-enterostomy was usually performed in the presence of a stenotic pylorus; but even so, the bismuth meal left by the pyloric route. These results they explained by pointing out that the stomach can not empty itself entirely by gravity drainage even under the most favorable placing of the stoma, because intra-abdominal pressure is such as to make gravity drainage impossible from the stomach. The stomach is not a passive reservoir but a muscular organ, and after the ingestion of the food, as the intragastric pressure continues, the pylorus becomes the lowest point of the stomach and the intragastric pressure is greatest within the pyloric antrum.

They believe that *vicious circles* are caused by valves that are formed at the stoma by the pressure of food in the stomach and that these valves open only one way.

They oppose gastro-enterostomy, too, on the grounds of the production of duodenal kinks and the premature intermixture of intestinal juices and food. They recommend pyloroplasty, and in their studies of it found that the food left the stomach earlier than in gastro-enterostomy and always continued in a forward manner.

This work has made a deep impression on all who have studied the question. Leggett and Maury (2) performed a gastro-enterostomy on a dog and after recovery they fed the dog a little bag of shot tied to a string, so that after ingestion the course the shot took could be followed by means of the string. The bag of shot went out the

pylorus and back through the gastro-enterostomy opening and again out through the pylorus and again back through the gastro-enterostomy opening.

Paterson (3), in reviewing the physiologic effects of gastro-enterostomy, concluded that the procedure is not a drainage operation and, in order to justify the results, pointed out that after gastro-enterostomy the stomach is filled with bile and pancreatic juices (alkaline liquid) and concluded that it is the change in the reaction of the stomach contents that heals the ulcers.

Berg (4) re-emphasized the difficulties that are in the way of regarding gastro-enterostomy as a drainage operation. He expressed the fear that in the spasm of the pylorus caused by ulcer although gastro-enterostomy may relieve the spasm, the stoma may later heal up and the ulcer and pyloric spasm may recur. He, therefore, recommends occluding the pylorus in all cases of ulcer with gastro-enterostomy.

In spite of these adverse judgments, it must be admitted by all who have actually had experience that, in proper cases, simple gastro-enterostomy is a procedure of great benefit. Sherren (5), for instance, in a very carefully studied series of cases in which the patients were nearly all personally interviewed several years after the operation, reports that in seventy-two cases more or less relief was obtained in 96 per cent and complete cure is claimed in over 80 per cent of cases.

Our attention having been directed to this contradictory state of the evidence, we have subjected certain available patients of the thirty-two gastro-enterostomies made by one of us in the last three years to examination with the X-ray. The patients were from Dr. Outland's services at the Swedish Hospital and Bethany Hospital. On all of them he performed posterior gastro-enterostomy.

They were given twelve ounces of fermented milk mixed with 2 drachms of bismuth oxychloride, which makes a thick paste, and examined with the Holzknecht hanging diaphragm in the erect position. Plates were made only for record.

A résumé of the history and subjective condition of the patient at the time of examination with the X-ray reports is as follows in the six cases available for study:

CASE 1. M. Male, aet. 46, was first operated for kidney colic and a stone the size of a pigeon's egg removed from left kidney, March, 1910. On February 18, 1912, he re-entered the Swedish Hospital for pain in the epigastrium two hours after meals, belching, vomiting, and acid stomach. There was tenderness found in the epigastrium and over the eleventh intercostal space behind, on the right.

On February 19, 1912, the abdomen was opened and ulcer of the duodeum with cicatrix, just outside the common bile duct, found. Posterior gastro-enterostomy was done.

Examination April 5, 1913: The patient states that he feels better than he has for fifteen years. His dyspepsia has not bothered him for a year, except occasionally he has had some pain in the epigastrium which has no relation to meals. He has gained twelve pounds in weight.

Examination with the flouroscope after the ingestion of ten ounces of fermented milk and bismuth oxychloride: The lower border of the stomach is seen to be at the level of the umbilicus and the gastro-enterostomy stoma is at exactly the lowest portion of the stomach shadow. The food begins to leave the stomach immediately, through the gastro-enterostomy stoma. No food has left the stomach by the pylorus after an interval of thirty-five minutes. Peristalsis is observed along both the lesser and greater curvature. There are waves of peristalsis in the space between the stoma and the pylorus. The stomach is empty in about one and one half hours. (Fig. 2 and Plates 1 and 2.)

CASE 2. B. Male, aet. 61, entered the Swedish Hospital March 10, 1913. He had been ill for thirty-two years; he had three or four attacks of indigestion a year. They had been gradually getting worse. The attacks began with pain in the pit of the stomach which was almost continuous and which lasted about two weeks, gradually getting worse. Usually at the end of that time vomiting began which relieved the pain somewhat, but the vomiting continued for three or four weeks intermittently. He had never been jaundiced. He had lost no weight in the last year.

Operation March 12, 1913: A hard, cicatrized ulcer at the pylorus was found. No gall-stones were present. Posterior gastro-enterostomy was made.

Examination March 25, 1913: The patient had made a good operative recovery, is feeling and eating well.

The X-ray examination shows a two-pole stomach as the bismuth first enters; then it sinks into the broad lower pole about a finger-breadth below the umbilicus. The bismuth begins to leave by the stoma in three minutes; it trickles out slowly, stops

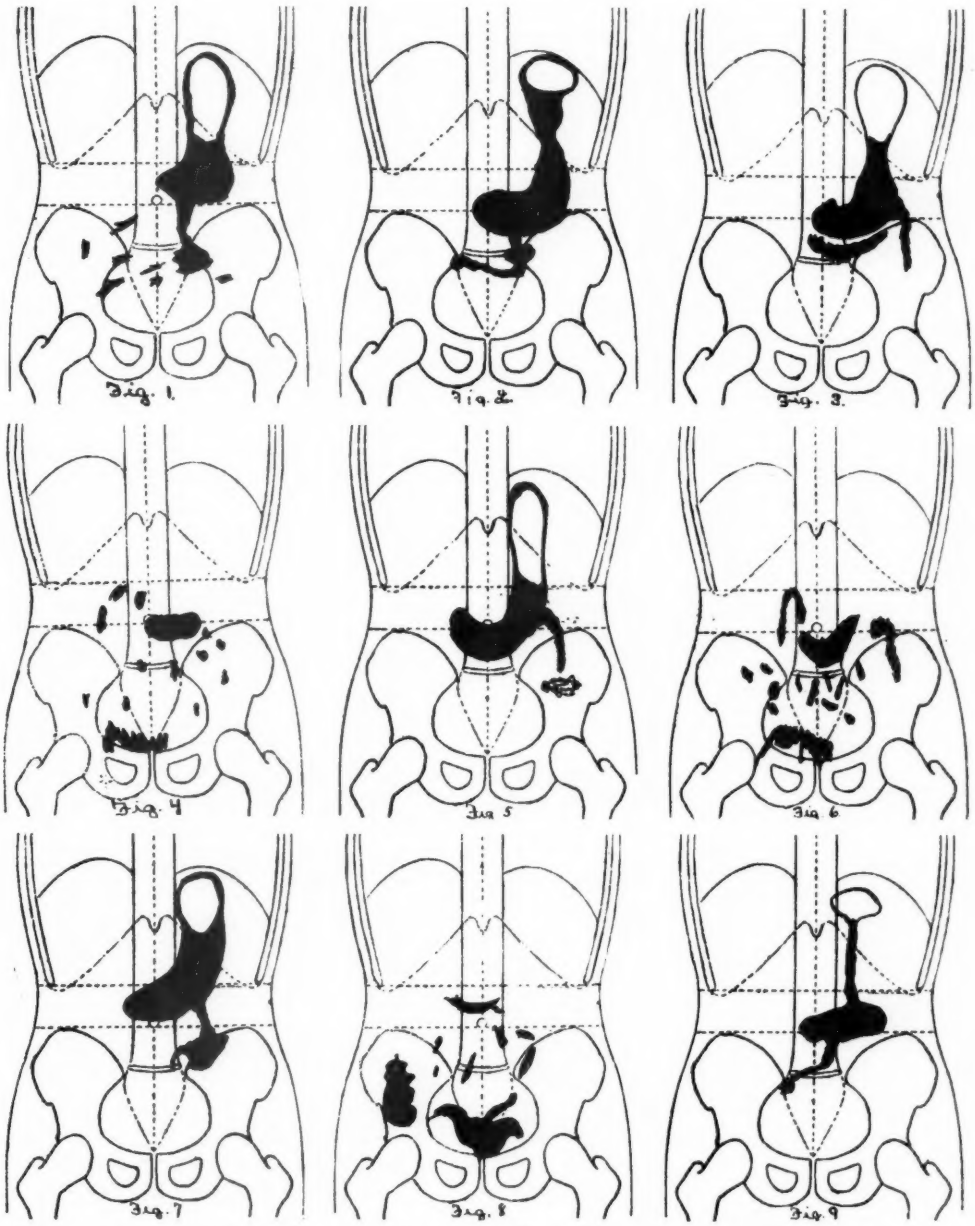
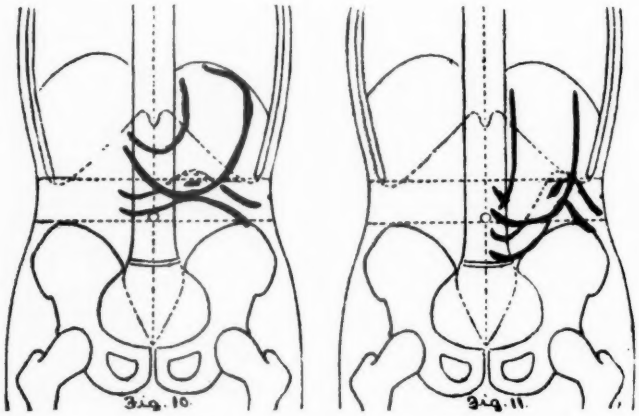


Fig. 1. Case 1, immediately after ingestion of the bismuth meal.
Fig. 2. Case 2, about three minutes after ingestion.
Fig. 3. Case 3, thirty minutes after ingestion.
Fig. 4. Case 3, three hours after ingestion.
Fig. 5. Case 4, thirty minutes after ingestion.
Fig. 6. Case 4, three hours after ingestion.
Fig. 7. Case 5, ten minutes after ingestion.
Fig. 8. Case 5, two and one half hours after ingestion.
Fig. 9. Case 6, ten minutes after ingestion.



Figs. 10 and 11. Diagram to illustrate the placing of the gastro-enterostomy stoma. Fig. 10 is the stoma in the horizontal position and Fig. 11 is the stoma in the erect position.

for a moment at the duodeno-jejunal junction and then passes to the right. The stoma is exactly at the lower pole of the stomach. No food has left by the pylorus at the end of twenty minutes. The stomach empties itself in less than two hours. (Fig. 2 and Plate 3.)

CASE 3. S. Female, aet. 41, entered the Swedish Hospital April 3, 1912. She had had an appendectomy done some time before for chronic dyspepsia, without much relief. At the time of her entrance she complained of pain in the epigastrium before meals. This condition dated back six years. She had had several attacks of hæmetemesis. The stomach contents showed a reaction of blood with the benzidine test. She had kept her weight pretty well. On physical examination nothing of pathologic interest was noted save a tense right rectus muscle and great tenderness in the epigastrium to the right.

Operation April 4, 1912: An old ulcer on the duodenal side of the pylorus was found. The pylorus was patent. Posterior gastro-enterostomy was made.

Examination April 21, 1913: Patient states that she has been feeling very well for the last six months. The old pain does not annoy her now. The bismuth meal reveals the stomach two fingers' breadth below the umbilicus. No food leaves either pylorus or the stoma for eight minutes, then the food, forced by gastric peristalsis, begins to leave by the stoma, which is not at the lower point of the stomach but about midway up the bismuth shadow in the erect position to the left. By pressure of the hand on the abdomen some bismuth can be forced out of the pylorus. At the interval of one hour the stomach is seen to contain some bismuth. Food is leaving both by the stoma and the pylorus. Bismuth can be seen in the portion of duodenum between the stoma and the pylorus. At the end of three hours the stomach is empty save for a very small residue. There is considerable bismuth in the duodenum. (Figs. 3 and 4 and Plate 4.)

CASE 4. M. Female, aet. 34. She entered the hospital May 4, 1912; she had suffered for many years with a very painful acid dyspepsia. The pain came on after meals and lasted for an hour or more. In the few months before her entrance she had vomited one or more times a day and was consequently very weak and had lost about fifteen pounds in weight.

At operation May 7, 1912, an ulcer cicatrix was found just at the pylorus causing stenosis. Posterior gastro-enterostomy was made.

Examination April 21, 1913: The patient states she is by no means well yet. The vomiting has stopped and she has regained her normal weight but still has pain after meals and distress in the epigastrium.

The bismuth meal shows a very long, hook-shaped stomach with the lesser curvature below the umbilicus. No food leaves the stomach at all for fifteen minutes; then accompanied by vigorous peristalsis a small projection shows midway up the bismuth column and to the left. Food then slowly leaves by the stoma and several minutes later some food leaves by the pylorus. Peristalsis is vigorous.

At the end of three and one half hours there is still some food in the stomach. Bismuth shadows are everywhere scattered through the small intestine. (Figs. 5 and 6 and Plate 5.)

CASE 5. R. Male, aet. 63. He was operated November 11, 1910. He had suffered for twenty years with pain in the epigastrium, attacks of vomiting, and constipation. At operation an ulcer with cicatrix was found at the pylorus. Posterior gastro-enterostomy was made.

Plate 1. Case 1, immediately after ingestion of the bismuth meal.

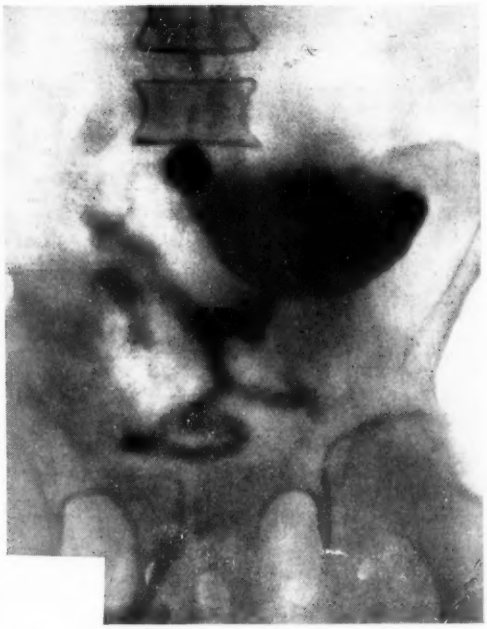


Plate 2. Case 1, half an hour after ingestion of the meal.

Examination March 1, 1913: He states that he has none of his old pain now and feels very well. He vomits sometimes if he overeats. The bowels are now too loose; he goes to stool about three times a day. He thinks that food leaves his stomach sooner than it used. He exercises no great concern with his diet, and eats about anything that he wishes.

The X-ray shows a broad lower pole of the stomach, the pyloric antrum being nearly a hand's breadth to the right of the umbilicus. The meal begins to leave practically immediately. The stoma is well placed at the lowest point of the dependent portion of the stomach. The edge of the greater curvature is above the pylorus. The bismuth meal leaves the stomach very rapidly through the stoma and appears to collect in a sort of reservoir below the umbilicus, apparently in the jejunum, before passing on into the small intestine. Peristaltic waves can be seen between the stoma and the pylorus on the greater curvature; no food leaves by the pylorus.

At the end of two and one half hours the stomach is empty save for a small saucer-shaped residue which is probably in the portion of the stomach between the stoma and the pylorus. The head of the bismuth column is in the ascending colon. Bismuth can be seen all through the small intestine. (Figs. 7 and 8 and Plate 6.)

Case 6. K. Male, aet. 49, entered the Swedish Hospital March 18, 1913. He complained of pain, before meals, located in the epigastrium and relieved by meals. He is bothered with acid eructations. He has never been jaundiced, does not often vomit, and has lost no weight. Operation on March 20, 1913: An old scar was found in the duodenum. The pylorus was patent. Posterior gastro-enterostomy was made.

Examination with the fluoroscope April 6, 1913: The lower pole of the stomach is to the left and below the umbilicus. The food begins to leave somewhat slowly by the stoma, which is well placed to drain the stomach. After entering the small intestine some of the bismuth goes downward and to the left toward the jejunum and some filters over to the right between the stoma and the pylorus along the duodenum; it does not, however, reach to the pylorus. After an interval of half an hour some bismuth begins to leave by the pylorus. The stomach is empty at the end of an hour and some of the bismuth is in the cæcum. (Fig. 9.)

It will be seen in all these cases that the gastro-enterostomy stoma does drain the stomach. In four of them the food leaves exclusively by the gastro-enterostomy stoma, and in two by the stoma and pylorus. That

Plate 3. Case 2, ten minutes after ingestion of the bismuth meal.

the food not only leaves the stomach by the stoma route, but that it leaves the stomach rapidly, and, in several instances, so rapidly that the conclusion is inevitable that the mechanism is a simple gravity drainage. As Aubourg says, with gallic felicity, the stomach appears to be merely a continuation of the œsophagus. That this condition of affairs is permanent is attested by Aubourg's case, in which the stoma was seen to be the outlet of the stomach ten years after gastro-enterostomy had been done.

This drainage does not occur so rapidly in all cases and the pylorus is not always put out of commission. In all of our cases, however, the emptying rate of the stomach is much faster than the emptying rate of the normal stomach, and in none of our cases did the meal leave by the pylorus alone. That this means of exit is not entirely dependent upon the closure of the pylorus can be attested by two cases (3 and 6) in which at operation no high grade of stenosis was present. Spasm may have been present, of course. But those authors who contend that the gastro-enterostomy stoma has no function, except with an absolutely occluded pylorus, have a very difficult case to prove. Actual studies upon gastro-enterostomy patients, sixty-two in all now on record, show that far from its being the difficult thing to get food out of the gastro-enterostomy opening as was once supposed, as a matter of fact, it leaves by that means with great ease in every case.

In fact, it would seem, in looking at these cases with the fluoroscope, that the difficulty is of the opposite sort—that the food leaves the stomach too rapidly. The wonder is that a procedure which makes so crude a gross change in the mechanism of digestion should give such excellent results. To explain this fact, we have noted in some of the cases the fact that the jejunum below the stoma forms a sort of pouch, or reservoir, which may take the function of retarding the passage of the food through the small intestine long enough

Plate 4. Case 3, thirty minutes after ingestion of the bismuth meal.

for digestion to be accomplished. This pouch can be well seen in the plate of Case 5.

In Cases 3 and 4, and in many of the cases in the literature, the stomach is not emptied exclusively by the stoma route, because the stoma is not at the lowest point of drainage of the stomach in the erect position. The position of the stomach in the horizontal position, that is, during the operation, is not the same as when the patient assumes the erect position. This may be misleading in the placing of the gastro-enterostomy opening. Especially is this true if there is any gastroptosis. In the horizontal position the pylorus moves upward toward the diaphragm and toward the right so that the greater curvature is horizontal and above the umbilicus. On assuming the erect position the pylorus sinks to the level of or below the umbilicus and usually becomes nearly the lowest point of the stomach; the greater curvature is then vertical and to the left. A gastro-enterostomy opening, then, placed on the posterior wall of the stomach at the lowest point in the horizontal position will not be at the lowest point in the erect position. We would recommend, then, that in placing the opening it would be as well to place it as close to the antrum of the pylorus as possible, provided the pylorus is not held high in the abdomen by adhesions. (Figs. 10 and 11.)

Plate 5. Case 4, thirty minutes after the ingestion of the bismuth meal.

Plate 6. Case 5, ten minutes after the ingestion of the bismuth meal.

One criticism which might be brought against our observations might deal with the character of the meal used. Cannon and Blake used canned salmon in order to have bulky food. The German observers, however, report practically the same results as ours, using bismuth and acacia paste. Furthermore, the rich fermented milk we used is practically a solid food after it reaches the stomach.

We observed no vicious circles. In certain patients the duodenum between the stoma and the pylorus was seen to be full of bismuth, but no bismuth was seen re-entering the stomach through the pylorus, nor any entering through the stoma. It is difficult to reconcile the idea of a vicious circle with the idea of a

Plate 7. Case of gastrectomy, ten minutes after the ingestion of the bismuth meal, to show the shadow of the stoma for purposes of comparison.

high intragastric pressure due to the movements of the stomach which is so insistently emphasized by certain writers.

In order to furnish a standard of comparison, we reproduce in Plate 7 the X-ray picture of a case of gastrectomy; the shadow of the bismuth coming out of the stoma corresponds to the similar shadows in our pictures of gastro-enterostomy.

In reviewing the literature we were somewhat surprised to find that there were a number of cases on record on the Continent in which the bismuth meal and X-ray had been used to study gastro-enterostomy. Aubourg (6) reported one case, Härtel (7) studied 22, Hesse (8) studied 31, and Maunz (9) studied 2. There are then 56 cases in all, to which we add 6—enough, it would seem, for some conclusions.

The bulk of the evidence is against the conclusions of Cannon and Blake, and Leggett and Maury. The great service of Cannon and Blake's work was to emphasize the necessity for making the stoma large enough; and to emphasize the fact that the operation is permissible only with a stenosis of the pylorus. It was largely, we believe, because the animals they were working on did not have any pyloric stenosis that their results were not in accord with the results observed on human clinical material. Of Leggett and Maury's experiment we can only say that it is difficult to imagine an experiment which mimicked the actual condition which they set out to illuminate as poorly as theirs did. The subject was an animal whose trunk is horizontal, so that a gastro-enterostomy would not under any circumstances be a drainage operation, the pylorus was open, there was neither ulcer spasm or stenosis present, and the food was represented by a bag of shot from which trailed a string which was anchored to the dog's pharynx.

It is perhaps permissible to say of Berg's remarkable position—that the pylorus should be occluded with every gastro-enterostomy,—that the evidence which he elaborates to prove gastro-enterostomy is not a drainage operation was originally adduced by Cannon and Blake (whom he does not credit); that he describes no new experiments of his own; that he refers vaguely to some good results from the operation without furnishing any case histories, and mentions very gingerly (in a footnote) the study of these cases with the X-ray.

Aubourg's patient was 44 years old, and in 1900 had been operated upon by Professor Hartmann for pain after meals, and a gastro-enterostomy had been done. The X-ray examination in 1910 showed that the function of the gastro-entero-anastomosis was perfect. The bismuth left the stomach as soon as it was ingested and was shortly seen in the left iliac fossa. The stomach was practically empty ten minutes after the ingestion of the bismuth meal.

Maunz examined two cases on whom posterior gastro-enterostomy had been done. In both cases the bismuth meal left through the stoma first and then later, in one case, by the pylorus. So rapid was the emptying rate of the stomach that the author feels that he should warn against making too large a gastro-enterostomy opening.

Hesse studies 31 patients; they were examined at periods of from 1 to 3 years after gastro-enterostomy. He states no conclusions but gives very complete protocols of the

findings with figures and plates. His findings were in no general essential different from the conclusions expressed in this and in Härtel's papers.

Härtel has a very complete and interesting review of the condition of the stomach after gastro-enterostomy based upon the study of 22 cases. The clinical results of these cases showed 16 cured, 3 bettered, and 3 in whom recurrence of symptoms had occurred. They were examined with bismuth meals of milk and acacia at intervals of 4 months to 3 years after operation; most of them were from 6 months to 1½ years after. He distinguishes two chief groups of the mechanism:

1. The emptying takes place through the stoma with no drainage through the pylorus or only very slight pyloric drainage. (In all cases of organic stenosis of the pylorus, duodenum, or the mid part of the stomach, 11 cases.)

2. The emptying of the stomach took place both by means of the pylorus and stoma. In the majority (7) of the cases they played about an equal part. In three cases the pylorus did more than the stoma. (In all gastric ailments with a normal pylorus or callous ulcer without stenosis, with the exception of the eleventh case in the series.)

The bismuth meal, after ingestion, stays in the stomach and expands it. The emptying of the stomach takes place often gradually, but begins earlier and is finished sooner than normally. The emptying of the stomach begins even before the stomach is filled.

The cure of a pyloric stenosis, Härtel believes, never takes place, but the meals keep going out through the stoma indefinitely. His conclusions are as follows:

"The emptying by the stoma is not strictly due to gravity, but the emptying follows the physiologic laws of the stomach itself. The active work of the stomach is taken up by the stoma and that is the preferred route, and the highest intragastric pressure is over the stoma.

"The good results by the gastro-enterostomy depend upon the implantation of the stoma. However, when gastro-enterostomy is done, no matter where one puts the stoma, one will get results; the new opening, though perhaps not physiologically perfect. will nevertheless play the door.

"Spastic conditions of the pylorus are aided by gastro-enterostomy and the pyloric passage is re-established.

"An attempt to effect the cure of an ulcer in the middle portion of the stomach by gastro-enterostomy will fail, for the food will not be diverted but will reach the pylorus exactly as under normal conditions."

CONCLUSIONS

1. Gastro-enterostomy, if properly done, is a drainage operation.

2. After gastro-enterostomy, if the stoma is at the lowest part of the stomach in the erect position, the food leaves the stomach almost *exclusively* by the gastro-enterostomy opening.

3. Under these conditions the stomach is emptied with great rapidity.

4. Gastro-enterostomy should be done only in the presence of pyloric stenosis, or pyloric spasm due to duodenal or gastric ulcer.

5. The gastro-enterostomy opening should be made large and placed as close as is permissible to the pyloric antrum.

6. In cases where the gastro-enterostomy opening does not quite drain the stomach, the food leaves both by means of the stoma and the pylorus. Even in these cases, however, the stomach empties itself faster than normal.

7. The clinical failures after gastro-enterostomy are probably due to the cases of faulty implantation of the stoma.

BIBLIOGRAPHY

1. Cannon and Blake. Ann. Surg., Phila., 1905, xli, No. 5.
2. Leggett and Maury. Ann. Surg., Phila., 1907, xlvi, No. 4.
3. Paterson. J. Am. M. Ass., 1907, xlix, No. 8.
4. Berg. J. Am. M. Ass., 1913, lx, No. 1.
5. Sherren. Lancet, Lond., 1912, clxxxiii, No. 4637.
6. Aubourg. Bull. Soc. de Radiol. med de Par., 1910, October 11.
7. Hesse. Ztschr. f. Röntgenol., 1912, 14, 5.
8. Härtel. Deutsche Ztschr. f. Chir., 1911, cix, 5-4.
9. Maunz. Beitr. z. klin. Chir., lxx, s. 343.

INTUSSUSCEPTION OF THE STOMACH AND DUODENUM DUE TO A GASTRIC POLYPUS

By HENRY WADE, M. D., F. R. C. S., Edinburgh, Scotland
Assistant Surgeon, Edinburgh Royal Infirmary and Leith Hospital

As far as I have been able to determine from a careful investigation of medical literature, no record so far exists of a patient who has successfully undergone operative treatment for a gastro-duodenal intussusception. The following case, therefore, appears worthy of being mentioned:

On the evening of June 20, 1912, I received a telephone message from Dr. Miller of Tranent, and was asked to meet him in consultation with his colleague, Dr. Johnstone, about a case he took to be suffering from acute intestinal obstruction. The patient was a married woman, 48 years of age, who had been more or less an invalid for about a year and had been previously operated on in the Royal Infirmary of Edinburgh, when gall-stones had been removed from the gall-bladder. When examined by us, the healed scar of the wound made at that operation was visible, and to the right of it a tender, palpable swelling could be made out that felt like a distended gall-bladder. There was a certain degree of abdominal distention. A detailed history of her illness is appended, in which it is recorded how the patient had been subjected to attacks of vomiting due to what had been taken to be partial intestinal obstruction. The present attack, however, was much more serious than any previous one and she was now in a critical condition. As operative treatment was immediately indicated this was undertaken, and the provisional diagnosis made was intestinal obstruction probably due to adhesions in the neighborhood of the gall-bladder. The swelling was accounted for by distention of the gall-bladder, the result of a recurrent cholecystitis. When the abdomen was opened by a vertical incision to the right of the former scar the gall-bladder was found united to the abdominal parietes and showed no evidence of recent disease. The swelling, which had been palpated, was observed, on throwing up the transverse colon, to be due to a distention of the upper six inches of the jejunum by a recent intussusception.

This distention was visible up to the duodeno-jejunal junction and could be felt to extend within the duodenum. It was obviously an intussusception and was easily reduced within the duodenum by manipulation. The appearances seen at this stage of the operation are indicated in the accompanying drawing (Fig. 1). In order to determine the site of origin of the invagination, the stomach and commencement of the duodenum were now examined, and the appearances seen are illustrated (Fig. 2). This drawing demonstrates the deep puckered invagination of the stomach wall at the site of its origin, and shows the duodenum distended tightly by the intussusception which had been partially reduced, the apex being now situated at the commencement of the third part of the duodenum. The intussusception was now completely reduced by manipulation. This was, however, a much more difficult proceeding than at the first stage where it lay within the jejunum, as the duodenum was very tightly distended. When the reduction was completed, there was felt within the pyloric antrum of the stomach a somewhat pedunculated tumor the size of a duck's egg. The invagination had originated here and this tumor had formed the apex of the intussusception. During the examination and subsequent manipulations the lower border of the pancreas was found to be separated from the duodenum by an unusually wide interval, and this portion of gut was exceptionally mobile. The portion of stomach invaginated was found to be obtained to a large extent from the fundus; the pylorus was visible and was situated at the margin of the ensheathing coat of the intussusception but was not drawn within the ring.

The tumor was now excised along with the portion of stomach wall to which it was attached, and the operation completed in the usual manner.

The patient made a rapid and most uneventful recovery.

DETAILED RECORD OF THE CASE

The patient was a married woman, 48 years of age, with a healthy grown-up family. The story of her illness can best be commenced in the early summer of 1911. Up to that time her health was good, but in the middle of the month of May she suddenly became ill and was admitted to the Royal Infirmary of Edinburgh under the care of Mr. Miles. From the record of her case taken at the time, which Mr. Miles has kindly allowed me access to and has permitted me to publish, I learn that three days prior to admission she was suddenly seized with severe pain in the lower part of the abdomen, and vomiting. It is recorded also that "pain has lasted ever since and she has been sick on both the last two days. The pulse has been regular, but for the past week she has noticed her stools to be paler in color than is usual. She has had previous attacks of pain shooting up to her shoulder but no history of actual jaundice, and has been troubled with indigestion but no pain after food. There has been no difficulty in micturition."

When examined, on admission, there was no palpable swelling but very marked tenderness over the right side of the abdomen in the hypochondriac and lumbar regions. The abdomen was rigid all over the right side. The patient's complexion was slightly tinged with jaundice.

On the day following examination the stools were observed to be clay-colored. She is described as having an anxious look. The tongue was furred but moist. Her previous health had been satisfactory except for several attacks of pain which usually radiated to the right shoulder.

On the day following admission, Mr. Miles operated under chloroform anæsthesia and opened the abdomen through the right rectus muscle. On examining the appendix it was found to be acutely inflamed and surrounded by a small quantity of pus contained within limiting adhesions. The appendix was removed and the gall-bladder explored, and as it contained stones it was opened and a quantity of clear fluid escaped with numerous yellow-faceted gall-stones. As bile did not flow, the cystic duct was opened. The gall-bladder and cystic duct were drained.

After the operation the patient's convalescence was rapid, and she returned home on the 9th of June, 1911, with the wound virtually closed.

According to the notes of her case provided me by Dr. Johnstone, who attended her at home, I find that she remained well for seven weeks afterwards. Thereafter there supervened sickness, and a feeling of nausea accompanied by a pain in the stomach and tenderness over the epigastric region, with vomiting which at times relieved the pain which was of a "tearing" character.

She returned to Mr. Miles' wards again on 4th of August, owing to an especially severe attack which had come on at 8 A. M. on the morning of the 3rd, when the patient, being out of bed at the time, was seized with a severe pain in the abdomen below the right mamma. This pain radiated up towards the scapula and across the front of the abdomen to the opposite side. The patient vomited five minutes afterwards, and continued to do so all day and night at frequent intervals. She was twice sick and according to the ward records the vomit is described as watery. She had no attacks of shivering. The patient stated that she had been told by her friends the day before admission to hospital that her complexion was of a yellower color.

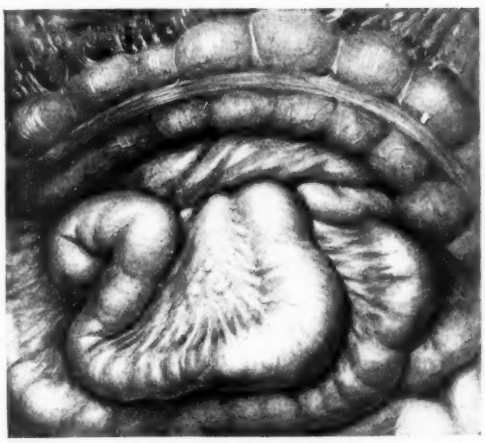


Fig. 1. Gastro-duodenal intussusception, showing lower limit of intussusception within the commencement of the jejunum.

When examined in hospital on this occasion, the epigastric region was slightly rigid and was tender to touch. She was detained in hospital for a week, during which time she improved rapidly, the pain and vomiting having ceased entirely. She was sent home with instructions to report at intervals, no operative treatment having been carried out.

After returning home she began light housework again, and found that she had to restrict her dietary as her stomach was easily upset, and she often found it necessary to cease taking food altogether for days at a time. Even with this precaution there was considerable retching with gaseous eructation, and a varying degree of pain. An interval of a week or two of fair health would elapse, during which time she could take more liberty as regards the variety of her food, but at the end of that period the former symptoms would reassert themselves with more or less severity.

According to Dr. Johnstone's notes from which the above facts are obtained, as a general rule the fact might be stated that with rest in bed, enemata to evacuate the bowels, and fluid diet, her condition would undergo some amelioration, but she was never

Fig. 2. Gastro-duodenal intussusception after partial reduction, showing puckered invagination of stomach, and intussusception within duodenum.

absolutely free from symptoms referable to her digestion with the exception of a period of six weeks at the beginning of this year 1912. For the next three or four months after that period she had the varying health such as already described. About the beginning of this year her condition became much worse. The nausea was constant, vomiting became very much more urgent, necessitating entire disallowance of all food by the mouth and it even manifested itself half an hour after taking sips of water. Much more material was voided from the stomach than was ingested, and although not unequivocally fecal in character partook somewhat of that nature. Pain started along with vomiting and their severity increased in equal proportion, but the pain would continue for some time after the vomiting ceased. There was no hæmatemesis present at any period of the illness. Constipation was a constant feature throughout her whole history.

On examining her abdomen during this acute exacerbation a fullness could be seen above the umbilicus, in the epigastric and inner part of the right hypochondriac region, and on continued examination a peristaltic wave was evident, traveling usually from right to left. On palpation this swelling was sausage-like, soft to touch, and easily defined, and corresponded as far as could be judged to the transverse colon both in position and appearance. A copious enema was given and a good result having followed, the bowel being evacuated twice, the swelling was not nearly so evident as it was at first, although it could still be felt in the same position. The condition was thought, therefore, to be probably a band causing partial obstruction of the transverse colon, but no certain diagnosis was possible. The band was accounted for by an omental adhesion remaining after the previous operation on the gall-bladder.

These attacks continued to recur with an increasing frequency, so that by the 20th of June, 1912, despite rest in bed and the treatment described, her condition of health had become critical, and when examined by us on the evening of that day, her pulse was 120 per minute — small, thready, and slightly intermittent. Her eyes were sunken, and the characteristic abdominal facies was evident. There was a mild degree of wandering. The temperature that had never varied much from the normal was now slightly subnormal.

The physical signs revealed on examining the abdomen have already been described, and the operative treatment detailed.

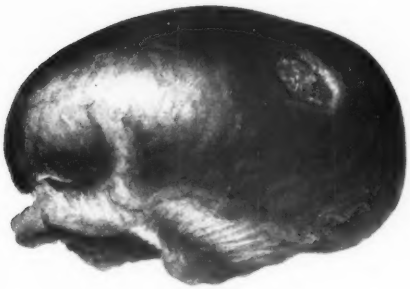


Fig. 3. Pedunculated myoma of stomach removed by operation (natural size), showing small ulcer of mucous membrane over vertex of growth.

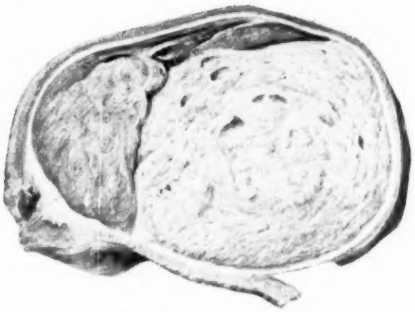


Fig. 4. Pedunculated myoma of stomach; on section (natural size) showing structure.

PATHOLOGICAL REPORT ON THE GASTRIC TUMOR REMOVED BY OPERATION

The tumor is of oval contour and measures 6 centimeters in length, 4½ in breadth, and 3½ in height.

It has a broad pedunculated attachment to the wall of the stomach, a portion of which has been excised with it. It is covered by congested mucous membrane, and a small circular ulcer has eroded the mucous membrane over the summit of the tumor. The mucous membrane is loosely attached to the tumor except over its vertex (Fig. 3).

On section the tumor is seen to have originated from the muscular coat of the stomach. The growth is covered by the mucous membrane that is thinned over the summit, and the submucous tissue and capsule of the tumor are seen as a clear, broad white line surrounding the tumor. The growth is of a firm but fleshy consistency and closely resembles the appearance of the ingrowth in an intra-canalicular fibroma of the female breast. Fig. 4 shows the appearance on section.

Microscopical examination shows the tumor to be a fibromyoma growing from the muscular coat of the stomach, enveloped in a fibrous capsule and covered by a loose layer of mucous membrane, the glandular element of which has been altered slightly by the pressure of the growth.

COMMENTARY ON CASE

A review of this case will reveal a clinical picture of disease that is distinct and definite. The initial stages are slightly obscured by the attack of appendicitis and cholelithiasis for which she was treated. If the tumor was present at this stage and occasionally prolapsing through the pyloric orifice, as is possible, its detection would have been most difficult, and even if it had been discovered it is unlikely that any surgeon would have felt justified in adding the operation of gastrectomy to a case already undergoing treatment for suppurative appendicitis and gallstone disease.

The gastric crises from which she suffered are to be explained by the occlusion of the pyloric orifice by the new growth; the slight jaundice can be accounted for by the prolapse of the tumor into the duodenum, where it mechanically occluded the outlet of the bile passages or by its presence caused duodenal catarrh and catarrh of the ducts. It is unlikely that this prolapse persisted, the total rest of the stomach that produced ultimate relief from the severe discomfort probably allowing a natural devagination to take place; the violent muscular contraction of the severe vomiting would probably help towards the same end.

The unnatural mobility of the duodenum and its loose connection to the pancreas possibly were of congenital origin, but more than likely were an acquired result of the repeated prolapse of the tumor and stomach wall into the above mentioned canal. In any case it must undoubtedly have facilitated the further descent of the intussusception.

The history of the last half-month of the

patient's illness strongly suggests that incomplete replacement had occurred during that period. The history of the last two days is that of total obstruction and partial devitalization of the entrant gut.

With a clinical picture so distinct and a treatment so easy and offering so excellent a prospect of a permanent cure, it is worth while inquiring into the possible frequency of such an occurrence, and the recorded cases of a similar nature.

As was mentioned at the commencement of this article, I have been unable to discover the records of any case similar to this in literature, although a careful search has been carried out. It seems unlikely, however, that the case is one of unique incidence.

BENIGN TUMORS OF THE STOMACH

The majority of innocent tumors of the stomach tend ultimately to develop towards the inner surface. They are usually sessile when of small size but become pedunculated as growth proceeds.

Classification. If classified according to their histological structure, adenomata, fibromata, lipomata, and myomata have been met with forming gastric polypi. According to Fenwick, the so-called "mucous polypus" is really a small adenoma which has undergone cystic degeneration.

Adenomata. These tumors are usually multiple, and vary in number from 2 to 3 to over 100. They are most frequently small, of uniform size, and distributed irregularly on the surface of the stomach. They are sometimes sessile but are usually pedunculated. These tumors are formed by hypertrophy of the glands, which are occasionally dilated to form small cysts. They are considered by certain writers as an indication of a chronic inflammatory condition of the stomach, a polypoid gastritis.

Besides these glandular polypi, which are small in size, there are others in which the connective tissue element is strongly developed, and the tumor attains a considerable size. Cornil has recorded a case where such a polypus, 5 cm. long by 3 cm. broad was ovoid and pedunculated, and obstructed the pylorus. Chiari has likewise reported a case of a large polypus which obstructed the pylorus. Chaput removed a polypus the size of the head of a fully developed fœtus. Tuffier figures one which is contained in the collection of the Dupuytren museum. This tumor is 10 cm. long, and was strangulated in the pylorus (Fig. 5.)

In one instance which came under the observation of Fenwick, four pedunculated adenomata, each as large as a pigeon's egg, were found attached to the margin of the pyloric ring and had produced partial obstruction of the orifice.

Ebstein met with 14 cases of polyadenomata in 600 necropsies (2.3 per cent). According to statistics compiled in London, they do not exceed .2 per cent. Out of 34 cases collected by Fenwick from various sources, the tumor was solitary in 14, multiple in the remaining 20.

Fibromata. These are either single or multiple. They usually occur in the pyloric end of the stomach (Fenwick). As a rule they are elongated or club-shaped, and measure from one to four inches in length (Bernabei). (Fig. 6).

Lipomata. These are rare tumors, of small size, sometimes multiple. They have been described by Virchow, von Russdorf, Benaky. They are most commonly situated in the central portion of the stomach, on its anterior wall.

Myomata and fibromyomata. These tumors when pedunculated take the form of firm, rounded tumors which vary from the size of a pea to that of a cherry, and are attached to the wall of the stomach by a thin pedicle. They may be single or multiple, and are usually situated in the pyloric region (Fenwick).

Myoma of the stomach was first described by Morgagni in 1762, since which time more than 40 other cases have been recorded (Fenwick.)

As a rule it takes the form of an oval or round, firm, solitary tumor, situated near the cardiac orifice or at the greater curvature, but it is sometimes encountered in the pyloric end of the stomach or in the duodenum (Wesener.) The tumor is usually of slow growth and tends to become submucous or subserous;

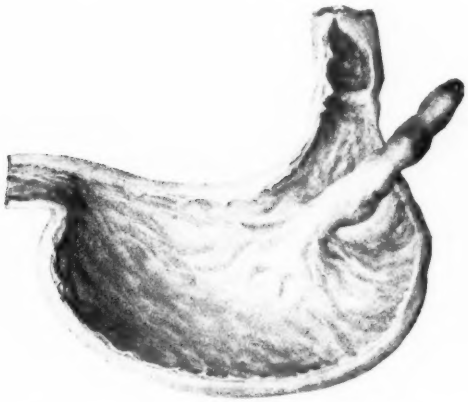


Fig. 5. Gastric polypus, causing pyloric obstruction (after Tuffier).

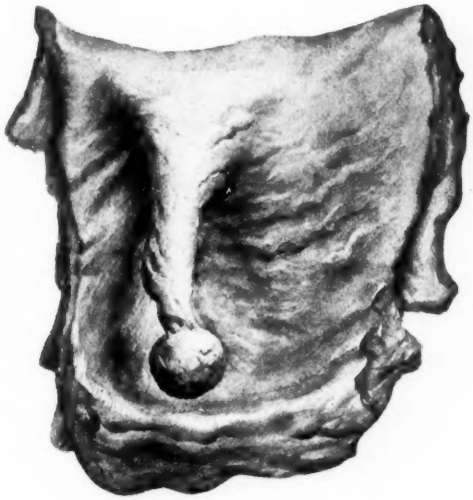


Fig. 6. Gastric polypus. A pedunculated fibroma with a long pedicle, natural size, (after Fenwick).

the former are prone to undergo cystic degeneration and to become pedunculated, while the latter occasionally assume a sarcomatous character (Brodowski.)

Without being pedunculated they may produce the symptoms of pyloric stenosis, as shown by Pernice and Herold. In Klemicke's case, ulceration of a myoma caused death from hæmorrhage.

V. Erlach removed a myoma from the stomach which weighed 5400. grammes; V. Eiselsberg one about the size of a man's head, and Kunze a lipomyoma 251 grammes in weight.

SYMPTONS

Where a pedunculated benign tumor of the stomach is situated in the pyloric region of the stomach, gastric phenomena are almost always present. These are mainly to be accounted for by the ball-valve action of the tumor at the pyloric orifice. Sudden and violent attacks of retching and vomiting which persist for a few minutes to several hours may develop, and in these cases there is usually a polypus of considerable length, the free extremity of which is occasionally prolapsed through the pyloric valve and suffers temporary strangulation (Fenwick.)

Between the attacks the patient frequently enjoys good health. In such cases the tumor presumably possesses a long pedicle and when not producing a temporary pyloric obstruction permits of free escape of the stomach contents. The stomach may become dilated when the obstruction is more permanent, and the patient has persistent ill-health with more acute and more serious sudden exacerbations; pain after food, flatulence, acidity and vomiting, with sudden attacks of severe epigastric pain and vomiting are experienced. Sometimes the vomit may be blood-stained from ulceration of the tumor or gastric wall. The latter may perforate as in the case recorded by Cleghorn. Loss of flesh, anorexia, and cachexia may develop, so that the case is taken to be one of cancer of the stomach, and the patient may die from exhaustion.

Gibson describes a case of ball-valve tumor of the stomach that was removed by operation from a man, aged 64, who had suffered from "gastric" symptoms of some years duration, which in conjunction with the objective signs were considered indicative of carcinoma of the stomach.

On opening the stomach, an innocent polypus was found which sprang from just inside the pylorus and had a ball-valve action.

Blake has recorded a similar case due to a pedunculated adenoma.

Beardsley has described a case where spontaneous detachment of a gastric polypus occurred and it was vomited by the patient.

Fatal hæmorrhage may result (Ellison.)

Intussusception, apart from the case already described, would not appear to have been considered as a possible complication of gastric polypus. Collier has, however, recorded a case where it developed from polypi in the duodenum.

The case was that of a young man aged 21. His illness commenced about 12 months previously, with pain across the upper part of the abdomen and vomiting. The symptoms increased in severity during the last six months, until one evening he was suddenly seized with more than usually severe pain and vomiting. The following morning a distinct tumor could be made out running obliquely across the abdomen from right to left. On opening the abdomen a large intussusception was found commencing a few inches from the pylorus. The patient sank a few hours after operation. At the post-mortem examination an enormous number of polypi were found varying in size from a pigeon's egg to a pea. They were scattered throughout the stomach and small intestine, the greatest number being in the duodenum and upper part of the jejunum. The specimen, which is now in the museum of the Royal College of Surgeons of England, shows the large lobulated villous growth situated in the duodenum, a short distance from the pylorus. This had a constricted attachment to the mucous membrane, and was the starting point of the intussusception of the bowel.

CONCLUSIONS

1. Benign tumors of the stomach are of occasional occurrence. The majority of these ultimately come to project within the gastric chamber and become pedunculated, forming gastric polypi.

2. These polypi when situated adjacent to the pyloric antrum, ultimately produce occlusion of the pylorus by a ball-valve action.

3. This is indicated by the signs and symptoms of acute pyloric obstruction.

4. The obstruction is usually intermittent, and the patient has intervals of good health.

5. A natural cure may result by separation of the polypus from torsion or strangulation of its pedicle.

6. A fatal issue may ensue from such complications as hæmorrhage, perforating ulcer, or profound debility.

7. A gastric polypus may produce a gastro-duodenal intussusception, reaching as low as the upper part of the jejunum.

8. Where gastric polypi are diagnosed by their clinical indications or recognized by the gastroscope in the region of the pyloric antrum, their removal by operation is indicated.

BIBLIOGRAPHY

FENWICK, SAMUEL, and SALTO, W. Cancer and Other Tumors of the Stomach, London, 1902.

CORNIL. Note sur les polypes de l'estomac. Société anatomique, 1863, p. 582.

CHIARI. Wiener klin. Wchnschr.

CHAPUT. Enorme adénome pédiculé de la paroi postérieurede l'estomac. Ablation de la tumeur, Guèrison. Examen histologique. Société anatomique, 1895, p. 534.

TUFFIER, TH. Chirurgie de l'estomac, Paris, 1907.

EBSTEIN. Arch. f. Anat. u. Physiol., 1864, p. 94.

BERNABEI. Virch. Jahrb., 1882, ii, 162.

VIRCHOW. Traité des tumeurs.

VON RUSSDORF. Lipom des magens. Deutsche. klin. Wchnschr., 1867, p. 115.

BENAKY. Lipome de l'estomac. Bull. et mém de la Soc. de Chir., Paris, 1905, p. 817.

WESENER. Virchow's Arch., xciii, p. 377.

BRODOWSKI. Virchow's Arch., 1876, lxvii, pp. 67, 227.

PERNICE. Quoted by Steiner.

STEINER. Ueber Myome des Magen-Darmkanals. Beitr. z. klin. Chir., 1898.

HEROLD. Quoted by Steiner.

KLEMICKE. Quoted by Steiner.

VON ERLACH. Zentralbl. f. all. Pathol., 1895, p. 240.

VON EISELSBERG. Arch. f. klin. Chir., liv, p. 568.

KUNZE. Arch. f. klin. Chir. 1890, p. 753.

CLEGHORN. N. Zealand Med. J., 1892, p. 55.

GIBSON. C. L. Ann. Surg., Phila.

GIBSON, C. L. Ann. Surg., Phila., 1907, xlv, p. 130.

BLAKE, J. A. Ditto.

BEARDSLEY. Tr. Path. Soc., viii, p. 219.

ELLISON. Australian Med. J., 1871, p. 284.

COLLIER. Tr. Path. Soc., Lond., 1896, xlvii, p. 46.

ILEO-APPENDICULAR HERNIA OF THE APPENDIX[1]

By LEWIS W. ALLEN, M. D., San Francisco
Visiting Surgeon to St. Luke's Hospital

As an introduction to the report of this case it may be interesting to the members of this society to briefly review the literature upon the subject of ileo-cæcal fossæ in general, and the ileo-appendicular fossa in particular.

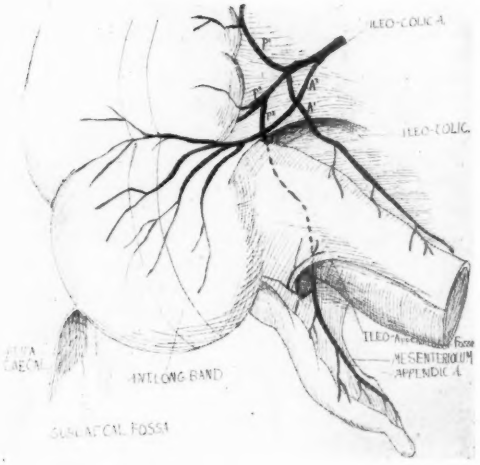
Historical. In 1775 Santorini (1) of Parma was the first to describe and illustrate fossæ in the ileo-cæcal region. No further mention is made of them until Huschke (2), in 1834, described two fossæ bounded by three folds brought out by traction on the vermiform appendix, which correspond in a general way to the more recent and thorough descriptions of the ileo-appendicular fossa—the superior fossa of Huschke—and the fossa of the mesentery of the appendix—the inferior fossa of Huschke, the recessus cæcalis of Waldeyer (3). Treitz (4), whose epoch-making work was published at Prague in 1857 on retroperitoneal hernia, first recognized that these herniæ occur in fossæ which are normal, and gave us at that time the first intelligent description of these fossæ. He added to the two pericæcal fossæ of Huschke a third, or subcæcal, lying behind or below the cæcum. In 1861 Luschka (5) added to these three a fourth, above the ileo-colic junction. In 1868 Waldeyer in a very thorough description of these fossæ classified them as follows:

1. Recessus ileo-cæcalis superior, or fossa of Luschka.
2. Recessus ileo-cæcalis inferior, or the upper fossa of Huschke.
3. Recessus cæcalis, or the lower fossa of Huschke.
4. Recessus subcæcalis, or fossa of Treitz.

In 1870 Hartmann (6), a pupil of Luschka, described three fossæ: ileo-cæcalis superior, ileo-cæcalis media, ileo-cæcalis infima (not previously described), omitting the subcæcalis. In 1885 Treve (7), in his Hunterian lectures on the anatomy of the intestinal canal and peritoneum in man, described the superior and inferior ileo-cæcal fossæ, thus adding his quota to the confusion in the nomenclature of this comparatively simple subject. His chief contribution to the study of these fossæ, however, was his theory as to the origin of his "bloodless" fold (the ileo-appendicular fold), which aroused considerable discussion and eventually was proven quite conclusively to be erroneous, as will be shown later. In 1887 Tuffier (8), in writing upon the cæcum and its herniæ, added nothing new to the description of the fossæ but showed the influence of the superior and inferior ligaments of the cæcum in maintaining its normal position and relations. To the exhaustive work of Jonnesco (9) on internal retroperitoneal herniæ, published in 1890 at Paris, we are mainly indebted for our present conception of the pericæcal fossæ and the substitution of a saner nomenclature for the earlier most confused one. He describes an ileo-cæcal fossa, an ileo-appendicular fossa, and two retrocæcal fossæ, an internal and external. Brösicke's (10) work, appearing in 1898 at Berlin, confirmed that of Jonnesco, but mentioned the fossa of Hartmann as exceptional. An English publication on this subject by Lockwood and Rolleston (11) appeared in 1892, and a more complete work by Berry (12) in 1897, founded largely on the investigations of Jonnesco. In the same year Moynihan, in the Arris and Gale lectures delivered at the Royal College of Surgeons of England, gave an exhaustive survey of the anatomy and surgery of the peritoneal fossæ under the title of "Retroperitoneal Hernia." This work was revised and in part rewritten by his colleague, J. F. Dobson, in a folio edition in 1906, and can be heartily recommended for its clear and comprehensive treatment of this interesting subject.

Dropping all the confusion of the past, we will therefore adopt the classification of Moynihan for pericæcal folds and fossæ, which is as follows:

[1]Read before the Surgical Section of the San Francisco County Medical Society, September 17, 1912.



The *primary* folds are:

1. The ileo-colic (or anterior vascular) fold.
2. The accessory ileo-colic fold.
3. The ileo-appendicular fold.
4. The meso-appendix (or posterior vascular) fold.

The fossæ formed by these are:

1. The ileo-colic fossa.
2. The accessory ileo-colic fossa.
3. The ileo-appendicular fossa.

The *secondary* folds formed by secondary physiological adhesion of the ascending colon to the posterior abdominal wall vary greatly, depending upon the time such coalition between the colon and cæcum with the posterior abdominal wall takes place. Two folds are quite constant, (*a*) the parieto-colic and (*b*) the mesenterico-parietal, forming the retrocæcal fossæ. Sometimes there is a third fold between these two, making an outer and inner retrocolic fossa. A fourth fossa, infracæcalis, described by Biesiadecki (13), is sometimes found and is of occasional surgical importance because of hernial protrusions of the small intestines into it followed by strangulation. It is a hernial protrusion of the peritoneum behind a sharp band formed at the junction of the loose upper half of the iliac fascia with the rigid lower half.

In this paper we are interested with the ileo-appendicular fossa. As this fossa differs somewhat in its formation from the other primary fossæ, and as its mode of origin has given rise to considerable discussion, it may be well to refresh our memory concerning the anatomical points involved. The ileo-colic fossa and the accessory ileo-colic fossa are dependent for their formation upon the branches of the ileo-colic artery; the ileo-appendicular fossa only partially so. The main extension of the ileo-colic artery passes anteriorly to the ileo-colic junction forming the edge of the ileo-colic (anterior vascular) fold and the anterior rim of the ileo-colic fossa. The appendicular artery usually passes posteriorly to the ileum. At the lower border of the ileum it gives off one of its chief branches, which passes first downward and to the right, then, curving upward in an anterior direction, it passes inward and to the left, forming the edge of the ileo-appendicular fold, or "bloodless" fold of Treves. It thus forms the anterior edge of the opening into the ileo-appendicular fossa.

The ileo-appendicular fold (superior ileo-cæcal fold, Waldeyer, Tuffier; "bloodless" fold, Treves; ileo-cæcal fold, Lockwood and Rolleston, Kelynack, and Berry; ileo-appendicular fold, Jonnesco, Juvara). Moynihan considers the name suggested by Jonnesco (ileo-appendicular fold) as describing most accurately the origin and attachment of the

peritoneal fold and as one so distinctive as to avoid any likelihood of confusion. "The fold extends from the lower border of the ileum—that directly opposite the line of the mesenteric attachment—to the anterior surface of the meso-appendix. It is quadrilateral in outline. The upper border is attached to the ileum for an extent which is extremely variable. An average length will be between 1½ to 2½ inches. The lower border extends from an angle formed by the appendix with the cæcum inward on the anterior surface of the meso-appendix along a line which is almost parallel with the superior border when the appendix is straightened out. Sometimes this line of adhesion is shifted to the appendix itself. Its outer or right border is attached to the inner aspect of the cæcum as far down as the root of the appendix. Its left or inner border is concave to the left and free. This edge contains the recurrent or ileo-appendicular artery given off almost immediately below the level of the ileum from the main appendicular. From its origin the little vessel runs slightly downwards and outwards in the meso-appendix, and then, turning, it forms an arch with the convexity downward and to the left as it runs upward to the ileum between the layers of the ileo-appendicular fold."

Besides the artery and veins this fold also holds between the two layers of the peritoneum some muscular fibers, first noticed by Luschka in 1861, which are continuous with the longitudinal fibers of the ileum and cæcum. Luschka considered that this fold acted as a regulator between the ileum and the cæcum, keeping a proper and advantageous relative position for these two viscera. The presence of these muscular fibers in the ileo-appendicular fold marks a difference in this fold from the other pericæcal folds and has led to considerable discussion as to its real origin.

Waldeyer first demonstrated that the ileo-colic (anterior vascular) fold and the meso-appendix (posterior vascular) fold owe their origin to the lifting up of a peritoneal reduplication by each of the vessels running from the ileo-colic artery to the cæcum and appendix, the extent and development of these folds being entirely and solely dependent upon these vessels, being in fact vascular folds. The origin of the ileo-appendicular fold, however, has not as yet received any entirely satisfactory explanation. Huntington (14), from a study of the comparative anatomy of the alimentary canal of apes, points out that the vascular folds vary with the freedom of the colon and cæcum, but the intermediate (ileo-appendicular) fold is of good size in all, though varying in the position and extent of its attachments. Treves, from a similar study, concludes that the intermediate (his "bloodless") fold is the remains of the earlier posterior vascular fold or true mesentery of the appendix, the meso-appendix as found in man being a substituted mesentery. Lockwood and Rolleston rather agree with Treves, but Jonnesco holds that the meso-appendix is the true appendicular mesentery, and the ileo-colic and ileo-appendicular folds are the mesentery of the cæcum. Berry agrees with this because of the established fact that the meso-appendix is the only constant fold. He considers that the appendix is gradually replacing the cæcum in functional activity because the meso-appendix is the largest, the most constant, and the most vascular of the three. On the other hand, Luschka and his pupil Hartmann held that the ileo-appendicular fold is produced by the raising up of the peritoneum by muscle fibers, already referred to, extending across the inferior ileo-cæcal angle. Toldt in 1879 elaborated this theory and considered, because this fold contained practically no blood-vessels and because the muscular fibers producing the fold only appeared at the end of the fifth month, while the anterior and posterior vascular folds are to be seen in the fourth month, that it was a portion of the peritoneum detached from the cæcum. These authors hold that the fold is muscular in origin.

Moynihan believes that the theory of Treves is without evidence and wholly untrue. Combining the ideas of Luschka and Brösicke, he considers the true explanation to be both muscular and vascular. He says: "If an embryo of the fourth month be examined, it will be found that, at the point of budding where the cæcum is developing, an artery

(the ileo-colic) supplies two branches to the bud, one anterior, the other posterior. These two vessels lie on the surface of the gut immediately beneath the layers of the peritoneum. As the cæcal bud increases in size, sprouting away from the mesenteric attachment, it would drag its vessels with it; but the cæcal growth is more rapid than the vascular. The result is that the vessels seek a short path and run straight to their destination instead of following the outline of the gut. In doing so they pull up and drag upon the peritoneum in their neighborhood, and so lead to the formation of two distinct plica, the anterior and posterior vascular folds already referred to. At the end of the fifth month, when the cæcal bud is easily recognizable, there is seen, in between the ileum and the cæcum, the intermediate fold already developed, and it contains between its layers the bundle of muscle fiber above mentioned. Now from the posterior or dorsal vessel, running in the posterior vascular fold, a branch is given off, which, running in a curved direction, mounts upward eventually to the ileum. This is the ileo-appendicular artery, which lies in the free edge of the ileo-appendicular fold. The later development of this fold, then, it would seem, depends upon the vessel in its free margin. This theory, therefore, looks upon the ileo-appendicular fold as of a twin origin. It is a compound fold. Primarily it is muscular, dependent upon the ileo-appendicular muscle. Later, its development is modified by and attributable to the ileo-appendicular artery, the recurrent branch of the main appendicular vessel. This being the case, the ileo-appendicular fold is, in part at least, secondary to and dependent upon the posterior vascular fold, the meso-appendix. It is the last fold to appear in the embryo, less constant than the meso-appendix, and receives its vessel (upon which it to some extent depends for its existence) from the posterior vascular fold. It cannot, therefore, be the primitive mesentery of the cæcum."

The ileo-appendicular fossa. Having now a clear understanding of the origin and location of the fold, the fossa is found between it and the meso-appendix, its size depending mainly upon the size of the fold.

Pathology. This fossa is subject to two pathological conditions, cysts and hernia. By the closure of the mouth of the fossa, cysts the size of a lemon have been observed occupying the site of the fossa. As to hernia into this fossa, either the small intestine or the vermiform appendix may become lodged in it. Moynihan has reported seven cases. Careful and thorough search of the literature of all cases of retroperitoneal hernia fails to add a single case to his list brought up to 1906.

Etiology. Dr. Nasse (15), reporting his case in 1896, in discussing the causes which lead to the formation of such herniæ mentions: (1) Brösicke's leaning to a mechanical theory, that it depends upon the relation between the size of the opening of the fossa, the firmness of the edges of the opening, and the abdominal pressure; (2) Jonnesco's theory that the appendix becomes caught by adhesions to the iliac fossa together with the neighboring ileum, which thus becomes an entering wedge for the admission of other portions of the intestines; (3) Tuffier's belief that an unusual fullness of the intestines, supplemented by an increase in the intra-abdominal pressure, would force the intestinal loops into the fossa. Probably all three enter into the development of a hernia.

Ileo-appendicular hernia of the appendix. Hernia of the appendix into the ileo-appendicular fossa has been studied by C. B. Lockwood alone of all surgical writers. His first observations were made on the cadaver and were first given to the profession in 1889 in his Hunterian lectures on hernia. In 1890, in the Transactions of the Pathological Society, London, vol. xli, p. 118, in an article on retroperitoneal hernia of the vermiform appendix, he quotes two cases apparently non-pathological found in autopsy dissection. In both, the vermiform appendix was thought to be absent. In one "a vermiform appendix two inches long, was discovered lying in a small blind pouch which ran behind and parallel with the ileum. There seemed no doubt that this pouch was an ileo-cæcal (now more specifically called ileo-appendicular) fossa." In the second the author simply states that the hernia took place into one of the ileo-cæcal fossæ. As he quotes Lichen-

stern, who classifies the ileo-cæcal fossæ into recessus ileo-cæcalis, recessus ileo-cæcalis superior and recessus ileo-cæcalis infima, this case can reasonably be placed in the more recent classification as a case of hernia of the vermiform appendix into the ileo-appendicular fossa, making two of this variety quoted by him. The chief interest in this last specimen, says Lockwood, lay in the fact that the vermiform appendix, lying only partially herniated into this fossa, almost completely disappeared when the cæcum was pulled downward; thus throwing light upon the mode of formation of these anomalies.

He refers to an article by Lichenstern (16), in Ziemssen's Cyclopædia of Medicine, where three cases of retrocæcal hernia of the appendix are cited, two of which were strangulated; but on looking up Lichenstern's article we find that these were retroperitoneal herniæ but not of the vermiform appendix. Lockwood in this early publication concludes "that retroperitoneal hernia of the vermiform appendix may occur into either the subcæcal or ileo-cæcal (ileo-appendicular) fossæ; further, that it may be either partial or complete; and, lastly, that the mouth of the fossa may become completely closed."

As causative factors, Lockwood thinks these herniæ may be either developmental or pathological. In the first alternative, whilst the subcæcal fossa is being formed during the descent of the cæcum, the appendix may become immured within it as is suggested by the case of partial hernia mentioned above. In the second, the appendix may be imprisoned in the fossa during the displacement of the cæcum and iliac peritoneum, which is caused by the formation of a large hernial sac, such as has been described. It, however, seems to me that this is very uncertain and cloudy reasoning. Finally, he says, it is possible to conceive that the appendix itself might by its own movements find its way into a retroperitoneal fossa which had been previously formed in the ordinary way.

Surgical aspects. In 1901 Lockwood develops the surgical aspects of this form of hernia of the appendix in a book entitled "Appendicitis, Its Pathology and Surgery" (17), and writes as follows: "The vermiform appendix may be herniated into either the ileo-cæcal or subcæcal fossa, but the former position is much the more common. The mouth of the ileo-cæcal fossa is situated at the ileo-cæcal angle, and is seen when the ileum and cæcum are lifted up. It runs upward behind the ileo-colic junction and parallel to the right colon. This fossa may be as long as three inches and easily admit the finger or a loop of the intestine. I have several times found the inflamed appendix in the ileo-cæcal (ileo-appendicular) fossa. When the hernia is but partial the appendix is easily found and withdrawn, but when the hernia is complete and the mouth of the fossa closed, the greatest difficulties may arise. It is possible that accumulations with their attendant troubles are more likely to occur within herniated appendices."

He cites two cases. One (No. 28, p. 113) was a complete hernia described as follows: "The appendix could not be discovered at the ileo-cæcal angle, beneath the cæcum, or in the pelvis. Something hard was felt along the inner edge of the right colon. . . . Some years before I had given attention to retroperitoneal hernia of the vermiform appendix. I had also, in conjunction with my friend Mr. Rolleston, investigated the anatomy and positions of the vermiform appendix (11), with the result that I am convinced that the vermiform appendix is never absent except as the result of disease. I have also learnt that it is not infrequently hidden away in either the ileo-cæcal or subcæcal fossa; and that the mouth of the fossa may become occluded and be most difficult to find. Being unable, therefore (in this case), to discover the vermiform appendix in any of its usual situations, I began to seek for it in the ileo-cæcal and subcæcal fossæ. When the cæcum was raised the peritoneum beneath looked perfectly smooth and without a trace of any fossa. A swelling of the most doubtful nature was felt beneath the commencement of the right colon. At length a delicate streak was observed running across the peritoneum of the iliac fossa close to the attachment of the ascending colon. A little pulling apart with dissecting forceps showed that this was the mouth of the fossa, within which the appen-

dix lay concealed and from which it easily turned out."

The other case (No. 33, p. 125), was only a partial hernia. "The appendix rose from the inner side of the cæcum and ran downward for about 2 cm., where it was bent at an acute angle to disappear into the ileo-cæcal (ileo-appendicular) fossa. About 5 cm. more of the appendix was pulled out of the fossa where it had coiled upon itself. The last 2 cm. of the appendix was as hard as India-rubber, and resumed its curve after it had been straightened out. The ileo-cæcal (ileo-appendicular) fossa was from 4 to 5 cm. deep, and would just admit the first two joints of the index finger."

He also mentions a case of acute strangulation of the appendix in the ileo-cæcal (ileo-appendicular) fossa described by Mr. Heaton (18); "The appendix, 5 inches long, was quite free and natural in appearance except for its distal end. This was tightly strangulated in a peritoneal sac which passed upward behind the junction of the ileum with the cæcum. This 'ileo-cæcal pouch' had a smooth rounded orifice, and was about the size of a walnut. The patient had been ill for five days with acute abdominal symptoms marked by recurring attacks of severe colic, collapse, and vomiting."

The further search of the literature for this particular type of retroperitoneal hernia has been very trying and difficult because all retroperitoneal herniæ had to be looked up, read and stricken out lest an ileo-appendicular hernia of the appendix might have been included with other retroperitoneal herniæ; all herniæ of the appendix had to be sought for that a retroperitoneal variety might not be overlooked; and lastly, the nomenclature of these pericæcal herniæ has been so confused that all possible varieties had to be searched out for fear that this particular form might be included under some other heading. After a most careful search only two other cases were found which might be included in our list, and these two are very doubtful.

Elliot (19) in 1891 reported an "appendix being found in the ileo-cæcal fossa." His description is that "the appendix was found embedded in adhesions, winding around under the cæcum in a fold of the peritoneum which Treves describes as an ileo-cæcal fossa." Apparently this was in the retrocæcal fossa, and should not be classified with our cases. He, however, cites a dissecting-room case of Mixter "where the appendix was actually lying in an ileo-cæcal fossa, differing only slightly from the one described by Treves." This, if admitted, would be the third dissecting-room case. In 1905, A. C. Wood (20), of Philadelphia, reported a case of "transmesenteric hernia of the appendix," but his description does not state through what mesentery the appendix herniated—whether he referred to the mesentery of the ileum or to that of the appendix itself. This I attempted to have cleared up by a statement from him, but could get no answer. If he referred to the mesentery of the ileum it was very similar to my own case about to be reported.

Murphy (21) refers to the possibility of such herniæ, but cites no cases. He says: "The appendix may be lodged in either of two of the pericæcal fossa (retroperitoneal hernia of the appendix). In many cases it can be readily extricated; in others the orifice of the fossa becomes closed by adhesions and the organ is found with the greatest difficulty. It is believed that inflammatory phenomena are more likely to originate in such herniated appendices, in which case the abscess is essentially retroperitoneal. Hernia of the appendix is more frequent into the ileo-appendicular fossa than into the subcæcal or retrocolic." This is also Lockwood's opinion but, judging from the reported surgical cases, I have not found this true.

To these I wish to add the following case:

Yoshida, a Japanese laborer, 36 years old, unmarried, entered St. Luke's Hospital October 5, 1911; from him we obtained the following history: Family and previous history negative as to its bearing upon the present illness. Twenty days before, the present trouble began with severe pain in the right side of the abdomen in the iliac region. After three or four days the pain subsided, only to come on again with more severity at the end of a week, continuing to the time of admission. He never had had any previous attack, and this one was unaccompanied by vomiting or diarrhœa, chills or

fever. Examination showed him to be thin but very muscular, with normal heart and lungs. The right rectus was rigid and there was tenderness over both sides, most marked over McBurney's point. No tympany. Pulse 56, temp. 97.2°. Blood count: H., 90; reds, 4,750,000; whites, 10,400; polynuclear, 84; large mononuclear, 9; small, 7. He was operated upon October 6, 1911, under nitrous oxide and ether. Kammerer incision and abdomen opened. A mass the size of a small lime could be felt, which was very freely movable. This was isolated from the general cavity by a single layer of abdominal pads without much exposure of the general viscera. This mass was observed to be on the inner side of what was considered to be the cæcum, but it was at once noticed on searching for a line of cleavage that the usual ease of finding such a point of attack was absent. The most probable point, at the junction of the mass with the bowel wall, was therefore opened and pus soon found. An abscess about the size of a walnut was opened, a dram of pus wiped out, and the cavity sterilized. The entire mass being so small and so circumscribed, it was decided to remove the appendix. Ligatures were passed for this purpose at the upper border of the mass. On tying and cutting these it was found that no proper mesentery of the appendix had been divided. Therefore in order to free the mass ligatures were passed below, and what was at first considered to be the lumen of the appendix was tied off and divided. This not freeing it, another was passed closer to the bowel, which proved to surround the real appendix. The other lower ligature was then examined again, a probe passed into it which discovered it to be the divided ureter. The other end was then sought above and found in the connective tissue, demonstrating that the right ureter had become enclosed in the mass of inflammatory tissue with the appendix. The mass was then removed entire, leaving the two ends of the ureter and the stump of the appendix in a field of retroperitoneal connective tissue. The stump of the appendix was first treated. On attempting to invert it into the cæcum it was found to be impossible to do so. It was further discovered on enlarging the field of operation that the ileum was *below* the previous site of the abscess, passing to the right over the top of the cæcum, which was drawn to the left up under it and the two united by fresh adhesions. On separating these adhesions and straightening out the ileum, it was found necessary to pass the stump of the appendix through the mesentery of the ileum before it could be inverted into the cæcum. This being done, the hole in the mesentery of the ileum was sutured. The two ends of the ureter were united by a Robson ureto-ureter anastomosis, and the free end of the ometum utilized to cover the raw peritoneal surface and the ureteral junction. A Morris wick drain was placed to the site of the abscess resting on the omentum and the walls of the abdomen closed about it, a second small drain being inserted more superficially.

In reviewing this case we find that the appendix was situated above the ileum and to the inner side of the ascending colon; that the stump of the appendix had to be passed beneath the ileum through its mesentery in order to be inverted into the cæcum; and that the whole mass was retroperitoneal, involving within itself one half to three quarters of an inch of the ureter (this much being found afterward on examination of the abscess mass). The only explanation of these conditions would be a hernia of the appendix into the ileo-appendicular fossa, its subsequent inflammation with abscess formation, and the involvement of the ureter within the inflammatory mass.

BIBLIOGRAPHY

1. SANTORINI. Tabulæ 17 Santorini. Parma, 1775.
2. HUSCHKE. Lehre von den Eigeweiden und Sinneorganen des menschliches Körpers. Leipzig, 1834.
3. WALDEYER. Hernia retroperitonealis nebst Bemerkungen zur Anatomie des Peritoneum, Breslau, 1868; Zum zweiten Mal abgedruckt. Virch. Arch., 1874.
4. TREITZ. Hernia retroperitonealis; ein Beitrag zur Gesichte innerer Hernien. Prague, 1857.
5. LUSCHKA. Ueber die Peritoneale Umhüllung des Blinddarms und über die Fossa ileo-cæcalis. Virch. Arch., xxi, 1861.
6. HARTMANN. Die Bauchfelltaschen in der Umgebung des Blinddarms. Inaug. Dissert. zur Erlangung der Doktorwürde, Tübingen, 1870.
7. TREVES. The Anatomy of the Intestinal Canal and Peritoneum in Man. Hunterian Lect., London, 1885.
8. TUFFIER. Étude sur le Cécum et ses Hernies. Arch. gén. de méd., June, 1887.
9. JONNESCO. Hernies internes rétropéritonéales. Paris, Steinheil, 1890.
10. BRÖSICKE. Ueber intra-abdominelle Hernien und Bauchfelltaschen. Berlin, 1891.
11. LOCKWOOD and ROLLESTON. On the Fossæ around the Cæcum, and the Position of the Vermiform Appendix, with Special Reference to Retroperitoneal Hernia. J. Anat. & Physiol., 1892, xxvi, 130.
12. BERRY. Cæcal Folds and Fossæ, and the Topographical Anatomy of the Vermiform Appendix. Edinburgh, 1897.
13. BIESIADECKI. Fossa iliaco-subfascialis; Untersuchungen aus dem path. Anatom. Inst. zu Krakau (s. bei Tarenetzki).
14. HUNTINGTON. Studies in the Development of the Alimentary Canal. I. Med. Rep. Soc. Lying-in Hosp., N. Y., 1893.
15. NASSE. A Case of Incarcerated Hernia in the Ileo-Appendicular Fossa. Arch. f. klin. Chir., 1896, p. 919.
16. LICHENSTERN. In Ziemssen's Cyclopædia of Medicine, vii, 550.
17. C. B. Lockwood. Appendicitis, Its Pathology and Surgery. Macmillan & Co., 1901, p. 13.
18. HEATON. Brit. M. J., 1898, xi, 1618.
19. ELLIOTT. Intern. J. Med. Sci., 1891, i.
20. A. C. WOOD. Ann. Surg., Phila., 1905, xlii, 262.
21. MURPHY. Keen's Surgery, 1910, iv, 735.

THE INDICATIONS FOR ABDOMINAL CÆSAREAN SECTION[1]

By REUBEN PETERSON, M. D., Ann Arbor, Michigan
Professor of Obstetrics and Gynecology, University of Michigan

IT is not the purpose of this paper to make an exhaustive study of the many indications for abdominal Cæsarean section. Such a review, while it might possibly be made interesting and profitable to the obstetrician, would be out of place before this body of general surgeons and gynecologists, whose work, as a rule and from choice, is not along obstetric lines. Therefore I propose to discuss some of the more important and commoner indications for the operation under consideration, illustrating the various indications by cases from my own practice.

First, let me say that it is my belief that the chapter on the indications for abdominal Cæsarean section must be rewritten, on account of the great advances made in the technique of the operation. Undoubtedly the results of abdominal Cæsarean section will be still more satisfactory, once the surgeon comes to a full realization of the fact that, unlike the intestine, the stomach, or the bladder, the pregnant uterus, where sepsis from below is present or liable to develop, cannot be incised by the abdominal route without grave danger of a fatal issue from peritonitis. It is difficult to keep this difference in mind. Still it must be done if the indications and contra-indications for the operation are to be intelligently studied.

Obstetrics is perhaps one of the most, if not *the* most, conservative department of medicine and surgery. The obstetrician, among other things, gives up a great deal of time to the consideration of how the fœtus or passenger shall best be conducted through the pelvis or the passage. Sometimes the latter is narrow or otherwise obstructed. Sometimes the fœtus in itself or in its position is at fault, and complicates the problem. At other times the difficulty lies with the power, or uterine contractions. The obstetrician's art consists in unraveling the tangle and so changing conditions as to make it possible for a live child to be born by the natural passages. And giving up so much time and thought to the problem, he very naturally is somewhat contemptuous of the surgeon who, waving aside the problem outlined above, settles the question by removing the child through the abdomen. Now I must confess that my sympathies are chiefly with the obstetrician. I am afraid that I am not any more in accord with the surgeon who does an abdominal Cæsarean section on the slightest provocation than I am with the operator who does not attempt to make a diagnosis of an abdominal growth, on the plea that such a procedure is useless, since he will find out what is the matter after the abdomen is opened. Neither operator is playing the intellectual game fairly; each is seeking the path of least resistance.

However, while my sympathies may be with the obstetrician, I cannot but think he has been at times ultraconservative, and that the results for both mother and child being obtained by the advocate of the abdominal route should lead him to revise his opinions, and see if at times prejudice has not prevented his adoption of certain procedures. To put it another way, the only right the obstetrician has to demand that the child be born through the natural passages is through his ability to show that by so doing a better mortality and morbidity for mother and child will result. When, through ultraconservatism or a desire to maintain a position at all hazards, the obstetrician's statistics in any class of cases compare unfavorably with those advocating more radical methods, the accoucheur is fighting a losing game. And the sooner he realizes this, the better will it be for his patients and for himself. Perhaps an illustration will help to make my meaning clear. For generations past, medical students have been taught when and how to apply high forceps. Teachers and pupils have become expert operators, and in many instances have saved the children with no injury to the mothers.

[1] Read before the Southern Surgical and Gynecological Association, December 18, 1912.

However, if it were to be shown that, in a given series of cases with heads at the superior strait, better maternal and fœtal results follow abdominal Cæsarean section, there should be nothing to hold the obstetrician to the subpubic route. Just because in the old days the results with high forceps were superior to intraabdominal methods, it does not naturally follow that the same holds true to-day. All of which goes to prove that obstetricians, as well as other people, while holding fast to old and tried methods, must be open to conviction and be broad enough to accept the new if that be shown superior.

The classification of Routh seems most suitable for a consideration of the indications for abdominal Cæsarean section. I shall take the liberty of only including the more common indications, conditions one is liable to meet with in the ordinary course of hospital or private obstetric practice.

1. Obstructions to labor: (*a*) Pelvic contractions, (*b*) fibromyomata, (*c*) ovarian tumors, (*d*) stenosis of cervix and vagina, (*e*) miscellaneous (previous ventrofixations; large size of child).

2. Uterine hæmorrhages: (*a*) Concealed accidental hæmorrhage, (*b*) placenta prævia.

3. Constitutional crises; eclampsia.

1. OBSTRUCTIONS TO LABOR

(*a*) *Contracted pelvis.* Probably more Cæsarean sections will be performed for this indication than for any other. A few years ago a comparatively rare operation, and performed only as a last resort, under unfavorable conditions and with correspondingly bad results, abdominal Cæsarean section has now become an elective operation. It is now undertaken with full confidence that in clean cases the most satisfactory results will follow.

The operation is imperatively demanded in cases where the conjugate vera measures 7.5 cm. or less, and the child is living. When the child is dead and the true conjugate is 6.3 cm. or under, Cæsarean section is still indicated, on account of the danger to the mother of attempts to deliver the craniotomized child through such a small pelvic diameter.

It must be borne in mind that there is much uncertainty as regards pelvic measurements. Until the patient with a medium contraction of the pelvis, say with a conjugate vera of from 8 to 9.5 cm., has had a test of labor, it is impossible to say whether she will be able to have a child through the natural passages or not. Therefore a primipara with a pelvis within these measurements should be given a test of labor. If after a suitable trial the head is still above the superior strait, with no progress, Cæsarean section is indicated or the advisability of pubiotomy should be considered.

The following case will serve as an illustration.

CASE 1. Miss L. M., aged 20, primipara. Pelvic measurements were: interspinous 20, intercristal 21.5, bisischial 9, true conjugate 8. Diagnosis, generally contracted pelvis. Patient was in labor for 24 hours, with no engagement of the head. Abdominal Cæsarean section, January 20, 1909. Mother made a good recovery. Child lived 24 hours, and died from enlarged thymus.

Looked at from another standpoint, the criticism might be made that the case was treated too conservatively, and that the conclusion could have been reached even before labor—that a natural birth with such measurements was impossible. But just here enters the element of doubt because the patient was a primipara, and an unknown quantity so far as her ability to drive a child of a certain size through this particular pelvis. As long as the patient was not subjected to repeated vaginal examinations and attempts at delivery from below, if the membranes were unruptured and she were not exhausted by long continued labor pains, her chances with an abdominal Cæsarean section were not diminished.

On the other hand, had the case been neglected, had the patient been repeatedly examined and many attempts made to deliver from below, abdominal Cæsarean section would have been strictly contra-indicated. Under these circumstances it would have been far better obstetrics in my opinion to perform a craniotomy. For a Cæsarean section under such circumstances would have meant almost sure sepsis and probable death of the mother, with very slight hope of saving the child, already jeopardized by attempts at delivery from below.

The case is different with multiparæ who have had a number of tests of labor and have lost their children from forceps or attempts at version or from other obstetric operations from below. Under these circumstances it is wise to raise the limit of the extent of pelvic contraction where an elective Cæsarean section is advisable.

The following is a case in point:

CASE 2. Mrs. L. M., aged 35, IX-para. First child born at seventh month; next two children at full term, and lived. Instruments used on last five children, all of whom died. Pelvimetry: Interspinous 20, intercristal 24, external conjugate 18, true conjugate 9. Diagnosis, generally contracted flat pelvis. Abdominal Cæsarean section March 17, 1907, at the onset of labor pains. Mother and child made good recoveries.

This patient was so well pleased with the results of the operation that she re-entered the hospital thirteen months later for another Cæsarean section, which was performed for the same conditions. Again mother and child made good recoveries. At this time, however, at the request of the patient and her husband, the tubes were cut and buried beneath the peritoneum, in order to sterilize the patient.

(*b*) *Uterine fibromyomata as indications for abdominal Cæsarean section.* Luckily, women with uterine fibroids either do not conceive or else they abort within the first three months of gestation. The reason for the early termination of the pregnancy is very apparent if one studies the ovum where the pregnancy was accidentally discovered after hysterectomy or where the uterus was removed without reference to the pregnancy. During the past five years I have been able to turn over four specimens of uterine fibromyomata complicated by early gestations of from two to three and a half months to my colleague, Dr. G. Carl Huber, professor of embryology. It is very important to the success of Dr. Huber's embryological studies that there be no pathological changes in the material examined. For this reason, embryos obtained from abortion cases are rather unsatisfactory, for necessarily abortion is a departure from the normal. Hence it was hoped that in these four cases mentioned perfectly normal embryos could be studied in situ, yet in each instance the embryo was imperfect, from degenerative changes due to hæmorrhages about the ovum.

If the embryo escape these changes and pregnancy continue, the treatment will depend upon the situation of the fibroid growth in the uterus and its relation to the pelvis. Also it must be borne in mind that a fibromyomatous uterus may be a handicapped organ, and that its contractile powers may be interfered with to such an extent as to permit of serious and at times fatal post-partum hæmorrhage. Rarely is the uterus the seat of a single tumor; hence myomectomy after the removal of the fœtus by abdominal Cæsarean section will be rarely called for. Fibroid tumors obstructing labor will almost always be cervical or intraligamentous growths. Other varieties will be lifted up out of the pelvis by the developing pregnant uterus, and will not as a rule obstruct labor. From the standpoint of safety to the mother it would seem best to do a Porro rather than the classical operation where the pregnancy or labor is complicated by uterine fibroids. However, in the case of a first pregnancy the mother should have the right to decide in favor of the retention of the uterus, so that future pregnancies will be possible.

The following is an example of a Porro Cæsarean section performed at full term for fibroid complicating pregnancy:

CASE 3. Mrs. A. F., multipara, aged 41. Normal pelvis. The last three confinements were terminated by forceps extractions. The patient nearly died from a post-partum hæmorrhage, presumably caused by a large fibroid growth in the right uterine wall. Porro Cæsarean section August 6, 1911. Mother and child made good recoveries.

(*c*) *Ovarian tumor complicating pregnancy as an indication for Cæsarean section.* Ovariotomy during pregnancy is a perfectly safe and reliable operation, giving a mortality of 3.3 per cent, with labor induced in only about 1 per cent of the cases. With normal pelvic measurements and no reasons for thinking the patient will not have a normal confinement, Cæsarean section is not indicated, even if the ovarian growth be removed during labor. The indications for Cæsarean section would be a cyst so situated that it

could not be removed without first reducing the size of the uterus. Every experienced abdominal operator can easily recall ovarian growths, situated within the folds of the broad ligament, where eradication would have been exceedingly difficult, or even impossible, in the presence of a full-term pregnant uterus.

Another indication for Cæsarean section set forth by Routh seems to me of value, namely, unusual rigidity or undilatability of the soft parts, as might occur in elderly primiparæ. In such patients a long, tedious labor might place too great a strain upon the recent abdominal wound, with perhaps serious results.

(*d*) *Stenosis of the cervix or vagina.* By stenosis of the cervix in this connection is not meant a rigid cervix which fails to yield to labor pains, but a cervix which is the seat of extensive scar tissue, usually dating from a previous confinement. This cicatricial cervical tissue is usually associated with extensive scar tissue in the vagina, so that the passage of the fœtus through the narrowed lower part of the birth canal would either be impossible or fraught with grave danger. Attempts at artificial dilatation of such scar tissue is also dangerous, because of the difficulty of limiting the direction and extent of the stretching, making Cæsarean section a much less dangerous procedure.

Attempts at delivery of a large child through a contracted outlet not infrequently result in extensive tears of cervix and vagina, vesicovaginal fistula, and complete rupture of the perineum. Repair of these injuries often requires extensive plastic operations, where tissue must be borrowed from one part to repair another. While usually the defects can be remedied, the repaired vaginal canal is usually a mass of scar tissue. A second labor, even under skillful handling, will mean a second series of tears, ruptures, and fistulæ. Under such conditions an abdominal Cæsarean section is indicated, and should be performed at full term as an elective operation.

The following is a case of this kind:

CASE 4. Mrs. T. D., aged 29, entered the University Hospital September 10, 1907. She had had three children, only the first of whom lived, the others having been stillborn. Last two labors were each over thirty hours in duration, and one child weighed fifteen pounds. Since the birth of the last child, three months ago, the patient has been unable to control her urine or fæces. Plastic operations upon bladder and rectum closed the vesicovaginal fistula and repaired complete rupture of perineum. So much scar tissue was left in the vagina that the patient was advised in case of subsequent pregnancy to enter the hospital for an elective Cæsarean section.

(*e*) *Miscellaneous indications.* 1. *Previous ventro- and vaginofixations of the uterus.* As has been shown from cases studied from the Johns Hopkins Clinic, the majority of patients subject to ventrosuspension of the uterus will pass through subsequent labors without mishap. But the number of cases presenting serious dystocia is so large as to render the operation unjustifiable in the child-bearing woman when often less dangerous operations will answer just as well. The same will apply with even more force to vaginal fixations, which have been especially disastrous where the women subsequently became pregnant.

Whenever, in a woman pregnant after a ventrofixation, the cervix is carried backward and upward near the promontory of the sacrum, and the uterus enlarges by distending and thinning the posterior uterine wall, an abdominal Cæsarean section is a much safer operation than attempts at delivery from below.

Before I recognized the danger of ventrosuspension in subsequent pregnancies, I was obliged to perform two Cæsarean sections on women who were previously operated upon in the University Clinic. The two mothers and children made uneventful recoveries.

2. *Large size of child.* The attempts to ascertain accurately the size of the child in utero have not been particularly successful. Careful palpation of the fœtal parts, together with Müller's method of ascertaining the size of the fœtal head relative to the inlet, and experience in many cases will throw some light upon the absolute or relative size of the child. Where the diagnosis of a very large child has been made, and this is borne out by the failure of the head to engage after many hours of labor, Cæsarean section is indicated even if the maternal pelvis be normal. This is illustrated by the following case:

CASE 5. Mrs. C. W., age 22. Patient had had one dead child at term, the labor lasting three days and terminated by forceps. Pelvic measurements normal. The patient was allowed to labor over forty-eight hours, since there were no signs of maternal exhaustion. At the end of this time, since the head was freely movable above the brim, the cervix was dilated and an internal version performed. The buttocks of the child could not be delivered through the pelvic inlet. Abdominal Cæsarean section was immediately performed and an 11-pound child delivered. Mother and child made good recoveries, although the former had a slight sepsis, presumably caused by the manipulations from below.

2. UTERINE HÆMORRHAGES

(*a*) *Concealed accidental hæmorrhage.* In this grave obstetrical accident the child is usually dead, and any treatment will be directed toward saving the life of the mother. Cæsarean section is indicated where the hæmorrhage is severe, the mother's condition alarming and growing worse, and the cervix so rigid as to require considerable time to secure dilatation enough to empty the uterus from below. Under such conditions probably better results will be obtained from abdominal than from vaginal Cæsarean section, unless the operator has had considerable experience with the vaginal route. As in operations for ruptured ectopic pregnancy, where the patient is in collapse and the hæmorrhage progressing, the paramount necessity is to stop the bleeding quickly, and this is best accomplished by the abdominal route. In concealed accidental hæmorrhage, fortunately rather a rare condition, the indication is to stop the bleeding and stop it quickly, if the patient's life is to be saved. But whether the abdominal or vaginal route be chosen, the uterus after being emptied should be removed. For experience has shown that in the kind of hæmorrhage under discussion the uterus does not contract as it is accustomed to when emptied, but is more apt to remain in a state of atony, which means death from post-partum hæmorrhage. Hysterectomy is also demanded to guard against sepsis, which is very liable to develop after severe hæmorrhage from the pregnant uterus.

(*b*) *Placenta prævia.* Abdominal Cæsarean section is only exceptionally indicated in placenta prævia. In the majority of cases the cervix is soft enough to yield to dilatation, so that various intrauterine manipulations can be employed with a view to stopping the hæmorrhage. In rare cases, as in old primiparæ, the cervix may be rigid and undilatable. That is, enough dilatation for effective intrauterine work could only be secured at the expense of time, which would increase the danger for the mother and probably prove fatal to the child. Under such conditions, if the mother has not been infected by manipulations from below, Cæsarean section is indicated. The uterus should be removed as the final step in the operation, for the reasons stated when discussing the treatment of concealed hæmorrhage, namely, the increased danger from sepsis in the presence of severe hæmorrhage.

3. CONSTITUTIONAL CRISES

(*a*) *Eclampsia.* For those who do not believe in the immediate emptying of the uterus as soon as the patient has been seized with eclamptic convulsions, neither abdominal nor vaginal Cæsarean section are ever indicated. However, the majority of obstetricians believe that in the presence of eclampsia the uterus should be emptied quickly and with the least possible trauma. If the cervix is easily dilatable, neither vaginal nor abdominal Cæsarean section will be indicated. In the presence of a rigid cervix, however, either one or the other route is indicated, rather than the wasting of valuable time over slow cervical dilatation. In the majority of instances vaginal Cæsarean section is the preferable operation, since it is performed from below without entering the peritoneal cavity. Where the pelvis is contracted, abdominal Cæsarean section is indicated, provided the patient has not been infected from below by repeated examinations or unsuccessful attempts at delivery. Under such conditions craniotomy on the living or dead child is the preferable operation.

I am at the present time engaged in tabulating the results of 425 cases of eclampsia treated by abdominal Cæsarean section, and some very interesting facts are being brought out. Not only has the literature been carefully searched and all recorded cases been

collected, but many operators all over the world have been kind enough to furnish me with unpublished cases. Thus the statistics represent not the work of a few, but over two hundred operators.

The total maternal mortality, counting patients operated upon before the aseptic era, was 36.9 per cent, while this was reduced to 31.8 per cent if only the 317 patients operated upon since 1900 are counted. The fifty per cent mortality ascribed to abdominal Cæsarean section in the treatment of eclampsia can be explained by errors in the selection of cases, for many eclamptic patients were subjected to the operation who were hopelessly septic. These patients did not die from the eclampsia or the operation itself. Many of them perished because of poor judgment on the part of the operators. They would have died even if the operations had not been performed for eclampsia.

In 245 cases of eclampsia where there was no sepsis or very little chance of sepsis prior to the abdominal Cæsarean section, the maternal mortality was only 24 per cent. It is significant that in 50 cases where operative procedures preceded the Cæsarean sections, the maternal mortality was 48 per cent, the difference in mortality being due, not to the eclampsia, but to the sepsis accompanying the eclampsia, a condition which can be avoided once this relation of sepsis to Cæsarean section is fully realized by the profession.

The results of abdominal Cæsarean section for eclampsia so far as the fœtus is concerned should be, and as a matter of fact are, gratifying in the 425 cases. In 317 cases since 1900, where the fœtal statistics could be studied, the fœtal mortality was only 5.5 per cent. Even this mortality is reduced to 3.7 per cent in 132 cases where the sections were performed after from one to five eclamptic convulsions.

These statistics are quoted to show that the last word has not been said regarding the place of abdominal Cæsarean section in eclampsia. At least, the statistics in over 400 cases have shown beyond a doubt that no one is justified in dismissing the treatment of eclampsia by abdominal Cæsarean section with a short statement that the mortality is so high as to make it an unjustifiable operation.

TRANSPLANTATION OF TUMORS IN ANIMALS WITH SPONTANEOUSLY DEVELOPED TUMORS

By MOYER S. FLEISHER, M. D., and LEO LOEB, M. D., Saint Louis
From the Department of Pathology of the Barnard (Free) Skin and Cancer Hospital

THE large majority of all experiments in transplantation of tumors were carried out on normal animals. It was apparently tacitly assumed that the conditions existing in normal animals or in animals with an inoculated tumor on the one hand and in animals with a spontaneous tumor on the other hand were identical. The first experiments in which tumors were transplanted into animals with spontaneous tumors one of us reported about 11 years ago. Loeb (1) found at that time that pieces of an adenoma of the mammary gland of a white rat could be transplanted very much more easily into a rat in which the tumor originated than in other rats. Later Loeb and Leopold (2) found a similar condition to prevail in the case of a mixed tumor of the breast of a dog in which pieces of tumor could be easily inoculated in the animal in which the tumor originated, while the tumor could not be transplanted into other animals. It was especially noteworthy that in both these series of transplantations the transplanted pieces remained alive *in toto* in the animal in which the tumor had originated spontaneously, while in other individuals the whole transplanted piece, or at least its center, became necrotic, and as is well known, after transplantation of the ordinary tumors transplantable into other

individuals the center becomes necrotic while the periphery remains alive in cases of successful transplantation. Loeb (3) also reported later a few observations in mice which seemed to point to the conclusion that mice in which a tumor had originated spontaneously were more liable to form a good soil for the growth of spontaneous tumors of other mice than normal mice without spontaneous tumors. He had, however, made only very few observations concerning this point and his conclusion in this respect was only a tentative one.

A number of investigators confirmed our observation that tumors grew after transplantation in animals in which they had originated very much better than in normal control animals. Haaland (4), while confirming our conclusion that animals with spontaneous tumors form a better soil for the growth of their own tumors than normal mice, maintained that tumors which originated in other individuals of the same species could be transplanted just as well into normal mice as into other mice with spontaneous tumors. Within the last three years we resumed our former investigations on a larger scale, with the intention of making a more detailed analysis of the difference or similarity in the growth of tumors in normal mice on the one hand, and in mice with spontaneous tumors on the other hand. We will give here a brief summary of our results:

Fifteen mice were inoculated each with one piece, weighing approximately 70 milligrams, of their own tumor. In 14 of 15 mice (93%), the inoculated pieces grew. Two of the tumors used for inoculation of mice with spontaneous tumors were inoculated into 68 normal mice as a control experiment and growth was obtained only in two mice (3%). This confirms therefore our former result, namely, that the individuals in which the tumor originated formed a very much better soil for the life and growth of inoculated pieces than other normal mice.

We now inoculated another series of mice with spontaneous tumors, with pieces of spontaneous tumors which had originated in other mice. For these experiments we used 55 mice bearing spontaneous tumors. Of these 55 mice 16 were inoculated successfully, while in the 39 remaining mice the inoculated piece taken from another individual did not grow. We obtained, therefore, positive results in 29%. Sixty-nine normal mice were inoculated with the same pieces of spontaneous tumors. Among those 69 normal mice, tumors developed only in 5 mice. Positive results were therefore obtained only in 7%. For the inoculation 10 different spontaneous tumors were used. Five of these could be transplanted into other mice with spontaneous tumors. Only two of those 5 tumors which were transplantable into mice with other spontaneous tumors could be transplanted into normal mice, and here they grew in a smaller percentage of cases than in the mice with spontaneous tumors. No tumor that could not be easily transplanted into mice with spontaneous tumors grew in any normal mice. In these experiments especial care was taken that the different strains of white mice used in the case of mice with spontaneous tumors and in normal mice were the same, so that the results cannot be attributed to the difference in susceptibility to tumor inoculation which exists in various strains of mice. We believe that our results are sufficiently definite to permit the conclusion that in mice with spontaneous tumors there is a factor present which permits tumors in general to grow better than in mice in which no spontaneous tumors had developed.

There is therefore intimately connected with the development of a spontaneous tumor in an animal, a condition which favors tumor growth in general. There is, however, another conclusion to be drawn from our results. Inasmuch as the percentage of cases in which tumors grew in the same individuals in which they originated is considerably greater than the percentage of growth in other individuals with spontaneous tumors, we must assume that the great facility with which tumors grow in the individual in which they developed spontaneously is due to two factors. First, the factor which we mentioned, namely, the presence of a condition favoring tumor growth in general in animals affected with a spontaneous tumor, and secondly, a condition

not specific for tumors but applying to other tissues as well, a condition which favors the growth of certain animal tissues in the individual in which the tissue originated as compared with the growth of the same tissues in other individuals of the same species. This latter fact is evidently due to a chemical adaptation existing between the physical chemical character of the body fluids and the composition of the tissue.

Another experiment in which in one mouse the own tumor grew, while the spontaneous tumor of another mouse did not grow, also proves that the own tumor which developed spontaneously in a mouse has, after transplantation, an advantage over a tumor developed spontaneously in another mouse. In a similar experiment, however, both the spontaneously developed tumor of the same animal and a spontaneous tumor of another animal grew in the same mouse.

Bashford has shown that if we inoculate a very large quantity of tumor the number of takes is not so great as in cases in which only the average quantity of tumor is transplanted. After we had confirmed the observation of Bashford in the case of the ordinary transplanted tumors we made a similar experiment in mice with spontaneous tumors. If we inoculated in those mice five times the usual quantity used for an ordinary inoculation, we still obtained very good results, inasmuch as in 6 mice out of 8 used the tumors grew. The number of mice used in this experiment is as yet too small to permit of any conclusion as to a possible decrease in the number of takes in mice in which a very large quantity of their own tumor is used for inoculation. If, however, a decrease exists it does not seem to be considerable.

We know that the large majority of spontaneous tumors in mice cannot usually be transplanted into other normal mice. They grow only in a very small percentage of cases. These tumors are evidently very sensitive to the absence of those factors which constitute the specific adaptation which exists between the tissue and the body juices in each individual. In mice in which tumors developed spontaneously there is present a factor which compensates for, and therefore overcomes to a certain extent, the unfavorable conditions produced through the absence of the specific adaptation between the tissue and the body juices in other individuals of the same species. There can be found, however, as we know, certain tumors which are evidently very much less sensitive to the absence of this specific adaptation between tissues and body juices of an individual, and which grow very well in a very much larger number of individuals of the same species, sometimes in almost all the animals of a certain strain. It was of interest to investigate how the easily transplantable tumor grew in mice with spontaneous tumors. Here I shall give merely a brief summary of some of our results. We used for these experiments a tumor, number 9, found in our laboratory, which we had transplanted through many generations of mice. Number 9 grew in mice with spontaneous tumors approximately in the same number of cases as in normal mice, perhaps slightly less. If we decrease the percentage of takes of number 9 by exposing it to a temperature of 44° during various periods of time, we find that these heated pieces also grow somewhat less in tumor mice with spontaneous tumors than in normal mice. If, on the other hand, we compare the growth of the heated tumor in mice with spontaneously developed tumors and in normal mice which had previously been successfully inoculated with a non-heated piece of number 9, we find that the heated pieces of number 9 grow decidedly better in mice with spontaneous tumors than in mice in which previously inoculated tumor number 9 is growing. We believe this observation is to be interpreted as indicating that the spontaneously developed tumors do not call forth immune mechanisms to the same extent as a rapidly growing number 9 tumor. Even if we inoculate a mouse with a spontaneously developed tumor first with its own tumor and 14 to 15 days later with number 9, number 9 grows very well notwithstanding the growth of the spontaneously developed tumor and a second tumor developing from the piece excised from the spontaneous tumor and retransplanted into the same animal.

The factors which, in normal mice, cause a retrogression of a certain number of tumors

in cases in which 4 or 5 times the average quantity of tumor material of number 9 has been transplanted are also operative in cases in which a larger quantity of tumor material of number 9 has been transplanted into mice with spontaneous tumors. If this retrogression is due to mechanisms of immunity called forth through the larger quantity of tumor material inoculated, such processes of immunity can evidently also be called forth in mice with spontaneous tumors. There is apparently no great difference in the amount of retrogression of the transplanted tumors observed in tumor mice inoculated with large quantities of number 9 and in normal control mice. In a similar manner we found that a previous or simultaneous inoculation with spleen tissue, in tumor mice just as in normal mice, prevents the growth of an ordinary transplantable tumor such as number 9. In this case also there does not seem to exist any marked difference between normal mice and mice with spontaneous tumors.

We may then conclude that the better growth of the ordinary, only slightly transplantable tumors in the animals in which the tumor originated is due to two factors: first, to the influence of the specific adaptation between tissues and the body juices of the same individual, and secondly, to an additional factor present in mice with spontaneous tumors, making them a better soil for the growth of the ordinary non-transplantable tumors than normal mice. This additional factor compensates to some extent for the lack of the specific adaptation between tissues and body juices. If we investigate the growth of transplantable tumors in which this sensitiveness to the lack of specific adaptation between tissue and body juices is not present to the same extent as in the large majority of ordinary tumors, then we find that it grows in mice with spontaneous tumors in a simular manner but perhaps not quite as well as in normal mice, especially if we investigate such an ordinary transplantable tumor under conditions in which its virulence has been experimentally decreased. Such material, however, grows better in mice with spontaneous tumors than in mice in which one of the ordinary rapidly growing transplantable tumors is present. If the spontaneous tumors call forth some immune reactions which are not present in normal mice, they call forth immune reactions of less intensity than the rapidly growing ordinary transplantable tumors. We furthermore have established the fact that those mechanisms which lead to an inhibition of growth in normal mice through an inoculation with a surplus of tumor or through a previous or simultaneous injection with spleen tissue are also operative in mice with spontaneous tumors and approximately to the same extent as in normal mice.

LITERATURE

1. Loeb, Leo. J. Med. Research, 1902, xiii, 1.
2. Loeb, Leo and Leopold, S. J. Med. Research, 1907, xvii.
3. Loeb, Leo. Univ. Penn. M. Bull., 1907, March-April.
4. Haaland. Fourth Scientific Report, Imperial Cancer Research Fund. 1911, p. 1.

SIGMOID ADHESION[1]

By HUBERT A. ROYSTER, A. B., M. D., Raleigh, North Carolina
Surgeon to Rex Hospital; Surgeon-in-Chief to St. Agnes' Hospital

A VERY interesting and important problem is the elucidation of left-sided pain in women. So much is being said and done about pain in the right abdomen of both males and females that our attention for the time is directed away from other regions. Kinks and membranes are the order of the day. Thus far those which are named are found upon the right, but not to be ignored are similar conditions occurring at the other end of the large intestine. Adhesion of the sigmoid is associated with definite symptoms, which I believe may be relieved by simple means.

Three years ago, in a paper[2] read before this association, I ventured to point out the existence of adhesions of the sigmoid to tube and broad ligament as giving rise to much of the suffering in cases of salpingitis. Further observation and experience have served only to strengthen the opinions then expressed. Indeed, the whole question has assumed a broader aspect, and it enters into the consideration of every pelvic case in our work whenever left-sided pain is a prominent symptom. This is a common complaint of women, but it is not always properly interpreted. Too often the ovary is regarded as the chief offender and is needlessly sacrificed. It is not too much to say that the ovaries themselves are rarely the actual seat of pain. More often tubal disease is the source of pelvic suffering and usually precedes ovarian involvement. In numerous instances neither tube nor ovary is affected, and some other explanation of the pain is demanded.

The particular thing which is characteristic of the sigmoid adhesion is pain during defecation — not so much before or after, but during the act. Patients will sometimes describe a temporary stoppage at a certain point. Constipation is the rule; but a small proportion of the cases have shown loose bowels with mucous discharges alternating with the constipation. This condition is seen largely in old women past the climacteric, in some of whom the uterus is plastered back against the rectum. There is also a dragging sensation which comes and goes, and even a constant aching. Usually the pain is low down, below the anterior spine of the ilium; at times it may be high, as far up as the splenic flexure.

Physical examination brings out very little evidence. Tenderness is never marked and does not exist at all in the majority of patients. The diagnosis must rest upon the subjective symptoms. The presence of the adhesion is to be suspected in any case of left-sided pain. Excluding pelvic disease is a great help, though not essential; for the sigmoid adhesion may occur on account of lesions in the pelvis or independent of them. In either event the indications are the same. If, however, affections of the ovary and of the tube can be eliminated, the bowel adhesion may be more positively predicted.

With the ordinary conditions in which the sigmoid is involved in widespread pelvic inflammation, just a dense conglomerate mass, we have no concern, for such adhesion is but an incident and is overshadowed by the pelvic disease. The form of adhesion generally seen as the cause of the symptoms just detailed is that in which the sigmoid is carried far down on the broad ligament, placed against the lateral wall of the pelvis, or even pushed up over the Fallopian tube. Of course, the position of the sigmoid flexure may normally show wide variations. It may be attached at different levels; it may be tense or slack. For the purpose of our present consideration it becomes pathological only when it is adherent in an abnormal position, fixed and permanent, and gives rise to symptoms.

In respect to the origin of the sigmoid adhesion we are very much at sea. Undoubtedly in some instances it has resulted

[2] South. M. J. iii, No. 1.

Read before the Southern Surgical and Gynecological Association, Old Point Comfort, Va., Dec. 17 to 19, 1912.

Fig. 1. The sigmoid adhesion as typically seen involving the Fallopian tube.

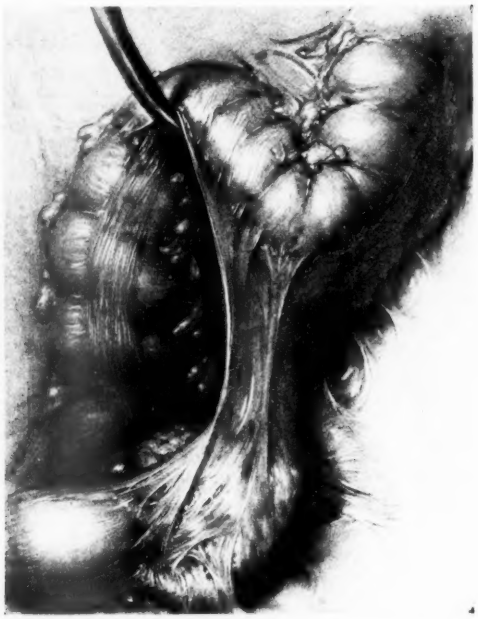


Fig. 2. The sigmoid is raised on the forceps, showing depth and extent of adhesion.

from previous mild cases of pelvic infection, in which the ovary may or may not have escaped. As a rule, we have observed that the more severe the symptoms, the more the tube was involved. But there are not a few which show no sign of adnexal disease, and these must have something to do with the factors that are supposed to work in other parts of the abdomen, viz., intestinal stasis and faulty posture. It seems evident that putrefaction inside the intestinal tube has much to do with all these specific adhesions, either as cause or effect or both. The vicious circle idea could not be better illustrated.

There is a clear-cut symptomatology associated with adhesion of the sigmoid. In addition to the 9 cases referred to in my former paper, there have appeared 15 more in which the sigmoid adhesion has been the sole lesion found to explain the symptoms. For the most part the diagnosis was made, tentatively or positively, before operation and found correct; in some instances the condition was not found when it was suspected; while in others it was discovered when not suspected. At any rate, one should be able to pick out the condition in the majority of cases. Typical examples are these: A young married woman who had given birth to three children complained incessantly of pain in her left side and was sent in as a case of tubal disease. Her greatest suffering was on going to stool and she was obstinately constipated. Pelvic examination was negative. Her abdomen was opened and a classic sigmoid adhesion revealed. This was dealt with and the abdomen closed. After the operation, even while lying in bed, she never required a purgative and has been entirely free from pain now more than two years. This is an operation which can be safely and successfully done for constipation.

Another instance was that of Mrs. W., aged 32, who several years before had had a still-born child and who had been twice operated on without relief for supposed pelvic infection. Left-sided pain and real obstipation were the features of her story, while scanty and painful menstruation added to her

discomfort. She presented the appearance and signs of chronic intestinal stasis. Three years ago an old dense adhesion of the sigmoid flexure to the tube was released with difficulty, and after a rather prolonged convalescence the patient was restored to health, both in feeling and in looks. At the present time she has no pain and is but rarely constipated. On the eighth day after operation the cul-de-sac had to be punctured to let out a collection of blood which had oozed slowly down from the insecurely approximated raw surface. This is likely to happen, particularly in cases of long standing, unless great care be exercised.

The method of dealing with the adhesion may be quoted from my former paper: "After snipping the bands which fix the sigmoid to the broad ligament, there are left two triangular raw surfaces, one on the bowel and the other on the ligament, with their bases together; these form a diamond-shaped area. The peritoneal edges are then closed over this space by continuous catgut, applied from below upward. The sigmoid is thus allowed to drop lower down into the pelvis, away from the tube and ligament—a maneuver which, in my opinion, must be executed to secure permanent relief. Covering all denuded places is not less important." The only modification of this technique which we now advise is the use of an interrupted catgut suture instead of a continuous one.

Incision at the outer border of the left rectus gives easier access to the parts. It will be more often necessary, however, to operate through the median line on account of the occasional association of other lesions in the pelvis. In either event the incision should be long, longer than is usual for ordinary abdominal work, in order that the manipulations may be readily carried on.

The real problem before us is to determine what makes the adhesion at this particular spot. It must be borne in mind that the large bowel is apt to kink at certain places where the turns are sharp, and they are more liable to occur at the fixed points. The cæco-ileac region has received its share of attention and the hepatic bend has given us the famous expression of "cobwebs in the attic." The splenic flexure is of more importance than has appeared from the little consideration given it. I think I have shown that the sigmoid adhesion is a distinct surgical entity and that it is amenable to proper treatment. Now the same agencies must be at work in all these conditions. Is the large bowel only at fault? All the physiologists and internists have told us that the condition known as "intestinal indigestion" is due to fermentation and insufficient digestive action in the small bowel. It is intimated even Lane has begun to inquire whether the whole affair does not originate in decomposition of material in the small intestine.

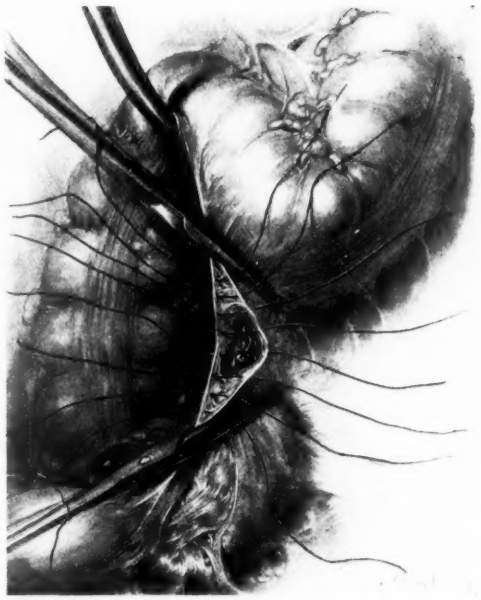


Fig. 3. The adhesion has been divided crosswise between forceps and is being sewed up longitudinally with interrupted catgut sutures. This allows the sigmoid to drop away from the tube and underneath the broad ligament.

Sigmoid adhesion may occur, first, from a combination of congenital predisposition, improper support, and intestinal putrefaction; or second, it may result from inflammatory conditions in the pelvis. In many cases both sets of causes obtain. No affection of its kind within the abdomen shows more definite signs or gives fairer promise of cure.

ACUTE INVAGINATION OF THE ILEUM SECONDARY TO SARCOMA OF THE SMALL INTESTINE[1]

Report of a Case

By C. JEFF. MILLER, M. D., New Orleans

TUMORS of all types, benign and malignant, are rarely observed as primary growths in the small intestine. Malignant growths are the most frequent and of these sarcoma constitutes the predominant type.

Moynihan collected 40 cases in 1906 and Lecéne in 1907 found records in the literature of 89 cases. These two tabulations seem to be the most complete yet published. From the time of the appearance of Lecéne's article up to date 26 other cases were reported, making a total of 115. A study of this material is exceedingly interesting, from both the pathological and clinical standpoint.

In 46 of Lecéne's cases the anatomopathological reports were complete and furnished the comparative incidence of the location of the growth. It was situated at the duodeno-jejunal junction in 3 cases, in the jejunum in 11, the ileum in 16, and in 6 at the ileocæcal junction.

Practically all authorities, with the exception of Libman, state that it rarely ever develops in the duodenum. Libman found among 42 cases the duodenum affected as often as the ileum. Perry and Shaw found only 9 cases of duodenal sarcoma recorded in Guy's Hospital Report in 68 years.

The following case is of interest because of some diagnostic features, the probable development of the growth upon cicatricial tissue following a previous attack of typhoid fever and the occurrence of intussusception, a complication noted in several of the reported cases in which the growth was small:

Mr. M., a well-nourished young man 22 years of age, was seized while at work with severe pain in the right lower quadrant of the abdomen. In a short time all of the symptoms characteristic of acute appendicitis developed. His family physician made a tentative diagnosis, advised rest, the application of ice-bags, restricted diet, and gave an enema that caused a copious bowel evacuation. He was very much relieved for 6 hours, then all the pains returned and his temperature rose to 100.2. He was suffering intensely when I saw him at midnight of the same day. The abdominal muscles were rigid, there was beginning distention and a distinct mass could be outlined in the ileocæcal region.

He was removed at once to the hospital and his abdomen opened. A quantity of amber-colored fluid flowed from the incision. When the cæcum was exposed it was found to be thickened, congested, and somewhat fixed, and contained a mass which was first thought to be fecal collection. The appendix was unusually long, œdematous and dilated at the end. After some difficulty the cæcum was delivered through the wound and the condition was found to be an invagination of a portion of the ileum through the ileocæcal valve.

The telescoped portion was easily reduced and measured about 15 inches. Inspection revealed a a contracted area completely surrounding the intestine 15 inches from the ileocæcal valve, which was evidently of long duration. The peritoneum over the area of stenosis seemed shriveled and fused with the muscular layer, and it was impossible to pass the tip of the little finger through the lumen of the bowel. Resection was performed and the lumen restored by a lateral anastomosis.

The abdomen was closed after drainage had been provided for through a stab wound incision above the pubes.

His convalescence for 12 days was uneventful. He then complained of a pain in the wound, which finally opened at the lower end and discharged a bloody serum and was followed by a rise of temperature for 4 or 5 days. On the 20th day after the operation he was taken violently ill, rapidly developed symptoms of severe shock and passed a large quantity of blood by the bowel. He was promptly removed to the operating room, where he died while preparations were being made to re-open the abdomen.

The incision was re-opened and the hæmorrhage found to have occurred from a slough in the mucus membrane of the cæcum near the valve, probably due to a thrombus. The site of the anastomosis appeared normal.

The gross specimen presented the typical appearance of cicatricial tissue. The lumen was contracted until it would admit nothing larger than an ordinary lead pencil. The

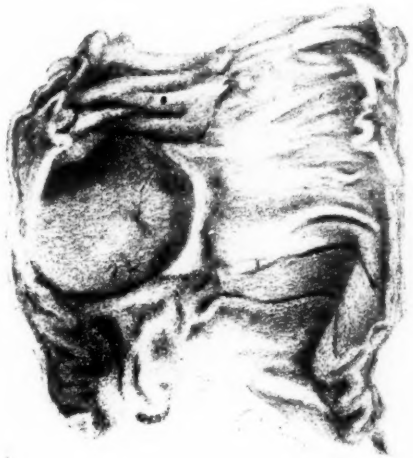
[1] Read before the Southern Surgical and Gynecological Association, Old Point Comfort, Va., December, 1912.

mesentery was also contracted for about 2 cm. distance from the intestine.

While the specimen was being examined his physician stated that he had treated the patient during a severe attack of typhoid fever, which was attended with intestinal hæmorrhages several years previous to the present illness, and suggested that the lesion was probably due to contraction following ulceration of Peyer's patches. When the specimen was laid open and the interior exposed, there was found a buttonlike mass somewhat larger than a twenty-five cent piece, situated in the center of the cicatricial area. The growth is well shown in the accompanying illustration, with the exception that it was not so thick as it appears in the drawing.

The following report upon the specimen was submitted by Dr. W. H. Harris, pathologist to the Presbyterian Hospital:

Mr. M., February, 1912. Pathological Description. Gross-segment from small intestine 10 cms. in length. It presents on its external surface just to one side of the mesenteric attachment an umbilicated puckered area completely surrounded by an elevated ridge. This ridge forms a symmetrical circle and measures 2.5 x 2.5 cm. In the center of the depression is a small mass which has broken through the serosa from within and forms an irregular protrusion on the outer surface. The caliber of the gut is considerably narrowed by this hard refracting mass. The lumen of the gut is so narrowed that only a small swab 5 mm. in caliber could be passed through and even this, as shown upon opening the gut, has torn the surface. Upon laying open the intestine, its internal surface presents a distinct buttonlike nodule corresponding in location to the area described on its external surface. It is distinctly round in shape, of a red color, and has a smooth, unbroken surface. It measures 2.3 x 2.3 cm. by 6 mm. in thickness. A section transversely through tumor shows the mass to be well limited by the intestinal coats, except near its center where it projects well towards the outer surface. Its edges adjacent to gut wall are clearly shown and are slightly irregular in their contour.



Microscopic. Tumor is found of irregular clusters of small black cells contained in a rather delicate stroma of connective tissue. The cells measure about 8–10 u. in size and stain a deep blue with eosin-hæmatoxylin. The nuclei are relatively large and occupy the greater part of the cells. Evidences of mitosis are seen scattered throughout. A vestige of the muscular coat of the intestine is present; it is very irregular in outline and shows degeneration. At one point the continuity of this coat is broken and the tumor cells have extended through and spread over its surface externally.

Germinal centers and other evidences of lymphoid follicles, or Peyer's patches, are not seen.

Diagnosis. Sarcoma of the small round cell type or lympho-sarcoma.

A search through the list of reported cases revealed only a few similar instances in which sudden acute symptoms gave the first warning of intestinal trouble. I found only 3 such cases in Moynihan's list. In the other 37 cases, symptoms of transitory abdominal pain, occasional vomiting attacks and nausea, preceded the recognition of the growth from a few weeks to over 3 years.

If there could be a cardinal symptom it would be the presence of a tumor. It was present in over 90 per cent of the cases when brought for examination or operation.

It is always present in children and nearly as constant in adults. More than half the cases were reported in patients over 40 years of age. Cachexia is only marked in children, except in the late stages.

Fever was often present, as would be expected from the large percentage in which ulceration occurs.

Constipation is not a reliable symptom though often present. Diarrhea was noted in a few.

Three cases have been reported as occurring in the ileum years after severe attacks of typhoid fever, and Nothnagel reported an instance of sarcoma that developed from tuberculous ulcerative scars.

From the case histories on record one must infer that few were correctly diagnosticated prior to operation. Anderson is responsible for the statement that he could find no record of a case in which the diagnosis could be made.

Libman, who has made an excellent study of the subject, has suggested the following clinical classification as of value in diagnosis:

1. Latent cases in which the tumor is suspected at autopsy; 2, cases in which the first symptoms are brought about by intestinal occlusion or perforation; 3, those in which a similarity to peritoneal tuberculosis is demonstrable; 4, cases in which icterus is the first symptom; 5, those in which no tumor can be felt; 6, cases in which a pronounced resemblance to appendicitis is present (Van Hook).

I find that no case that developed sudden abdominal symptoms was suspected previous to operation, and that the diagnosis of appendicitis had been made oftener than any other affection.

The cases in which the symptoms developed suddenly were often associated with acute obstruction and in several instances intussusception, such as related in the above history. This has been associated as a rule with quite small growths, in one instance no larger than a cherry.

The location of the growth may be of some diagnostic value. The higher in the intestinal tract the situation of the tumor the more pronounced are the symptoms. So far the X-ray has not been used enough to prove its true value. In a recent case of lipoma of the small intestine with invagination, the mass was demonstrated by X-ray. Obstruction of the bowel is a frequent complication, but stenosis of the intestine is rare. Lecéne found only 2 cases out of 89 in which stenosis occurred.

On the other hand, intestinal dilatation is the rule, an especial though not constant attendant phenomenon of lympho-sarcoma and due, according to Lecéne, to a progressive infiltration and final destruction of the smooth muscle fibers without defensive reaction of the connective tissue, in marked contrast to the changes common to carcinoma.

The round-cell type of tumor is recorded in more than 50 per cent of the cases; spindle cell and lympho-sarcoma the next most frequent, with scattering reports of 1 or 2 each of fibro, myxo, angio, giant-cell and alveo-sarcoma.

In 30 out of 46 instances the growth was single, in 16 multiple. It is curious to note the frequency of adhesions between the bladder and the involved coil of intestine. In 46 cases Lecéne reported adhesions in 12, 7 of which were instances in which the bladder was the involved structure.

The mesenteric glands are involved early in the course of the disease. It is interesting to note that among the cases in which remote metastases were recorded, the kidney was the organ most frequently involved.

The first fact impressed upon one who reads the collected reports is, that the surgeon sees the cases too late. There is already a palpable tumor in over 90 per cent of the cases when an operation is proposed, yet if Moynihan's list is carefully studied only 4 or 5 cases failed to present symptoms of abdominal disturbance of some sort, varying in duration from a few weeks to 3 years, all of which goes to illustrate the surgeon's great responsibility in passing upon the surgical aspects of chronic intestinal disturbances. Libman takes an extremely gloomy view of the surgical results, particularly in cases of lympho-sarcoma with metastases, in which even exploration hastens the end. Even with the acknowledgment before us that the diagnosis is seldom made before operation, or until the growth is pal-

pable, the results have not been altogether bad. Hahn reports a case free from recurrence for 8 years, Steinthal 1 for 4 years, and another for 3½ years; Mickulicz 1 for 2 years, Haggard, one over two years, and quite a number are recorded as having passed over a year without recurrence. In the case personally observed, it would appear that but for the complication of hæmorrhage, the patient had an excellent chance for a permanent recovery.

REFERENCES

1. Mayo. Tr. Am. Surg. Ass., Phila., 1909, xxvii.
2. Kanzler. Beitr. z. klin. Chir., xlviii, 1.
3. Moynihan. Abdominal Operations, 1906.
4. Lecéne. Travaux de Chirurgie (Hartmann), Paris, 1907.
5. Barling. Ann. Surg., Phila., 1907, xlv, 242.
6. McGlinn. N. Y. M. J., 1908, Dec. 12.
7. Erdmann. Ann. Surg., Phila., 1910, li, 122.
8. Anderson. Brit. Med. J., 1907, Oct.
9. Stern. Berlin klin. Wchnschr., 1909, No. 37.
10. Goebel. Zentralbl. f. Chir., 1910, 37, 1258.
11. Bondareff. Chirurgia (Russia), No. 127, (Zentralbl. f. Chir., 1908, xxv. 26).
12. LeRoy. Arch. internat. de Chir., iii, 2.
13. Munk. Beitr. z. klin. Chir., lx, p. 197.
14. Fletcher. Practitioner, Lond., 1909, Sept.
15. Scudder. Surg. Gynec. & Obst., 1911, xii, 73.
16. Steinthal. München. med. Wchnschr., 1904, p. 751.
17. Massotti. Riv. veneta di sc. med., Venezia 3–17. Aug. 28, 1912.
18. Goto. Beitr. z. Kentniss der Ileocecol Sarcoma. Arch. f. klin. Chir., 1911.
19. Kallionzis. Soc. de Chir. de Par., 1911, v, 36.
20. Cunéo. Soc. de Chir. de Par., 1911, v, 37.
21. Boisseu. These de Paris.
22. Shepherd. Montreal M. J., 1908.
23. Douglas. Ann. Surg., Phila., 1912, March.
24. Delanglade et Weill. Marseille méd. J., 1912, v, 49.
25. Haggard. J. Am. M. Ass., 1912, July.
26. Schmidelechner. Pest med. chir. Presse, 1909.
27. Keen's Surgery.

SUPRAPUBIC PROSTATECTOMY[1]

By HUGH CABOT, M. D., Boston

Chief, Genito-Urinary Department, Massachusetts General Hospital

I AM led to present this paper at this time less because I have new material to present than because I believe it to be the duty of each one of us who is engaged especially in this work to express from time to time his opinions upon important questions under discussion and to give his reasons for the faith that is in him. Even if no absolutely new facts are presented, information of value may be forthcoming because the facts are seen from a somewhat different angle. Furthermore, I feel that no apology is due to this association for the discussion of the subject of prostatectomy; as to this society, in times gone by, have been brought the contributions of Belfield, Bryson, Watson, Alexander and Young.

For the sake of clearness, and because I feel that the problems are of a somewhat different nature, I shall confine myself to the discussion of the management of those types of enlargement of the prostate commonly referred to as hypertrophy. I desire at this time to pay my respects to the phrase, hypertrophy of the prostate, as at once inaccurate and misleading. The process referred to by this name is not true hypertrophy. In the first place, as has been pointed out by many, including Geraghty, it is not a process correlated to other processes ordinarily referred to as hypertrophy, for it occurs at a time of life when atrophy and not hypertrophy is taking place. Again, this so-called hypertrophy involves only certain portions of the gland and if the term is to be used at all it should be clearly stated in what parts of the gland the abnormal tissue originates. Work modern and less modern seems to me to have made it abundantly clear that the process is not hypertrophy but the formation of new tissue of adenomatous character arising in certain portions of the gland and replacing in whole, or in part, the normal tissue. This distinction is important and not a mere

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, D. C., May 7, 1913.

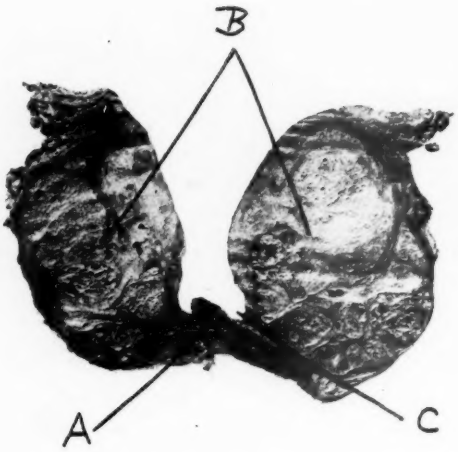


Fig. 1. Sagittal section of adenomatous prostate about level of verumontanum. A, posterior lobe; B, adenomatous masses in lateral lobes; C, line of cleavage at junction of lateral wall and floor of urethra.

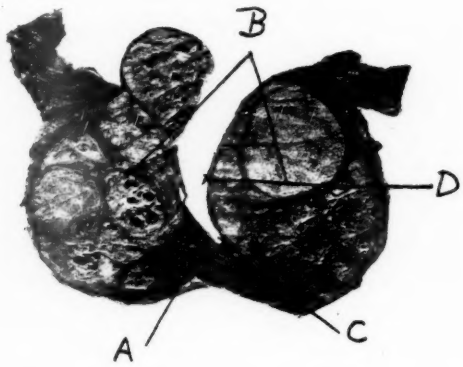


Fig. 2. Section of same prostate as Fig. 1, about 1 cm. further back. A, posterior lobe; B, adenomatous masses in lateral lobes; C, line of cleavage at junction of lateral wall and floor of urethra; D, mucous membrane from under which lateral mass B must be enucleated in Young's operation. Note the probability of leaving adenomatous tissue along the urethra when attempting to enucleate mass B from below by Young's method.

quibble, for upon a more or less thorough understanding of the position and origin of these adenomata must depend our belief as to the most successful and efficient methods of attacking them. If we were to proceed upon the theory that this is a true hypertrophy involving all portions of the gland we might readily reach the extraordinary position occupied by Mr. Freyer and Mr. Thompson Walker; viz., that by what he is pleased to call his (Freyer's) method, the whole gland is removed -- a question to which I shall have occasion to refer later. I hope that the weight of opinion of this association will be thrown in the direction of removing this troublesome misnomer from the field of medicine.

Origin of the adenomatous masses. Appreciating the fact that the process is due to newly formed tissue in the form of adenomatous masses, it then becomes essential to clearly apprehend from whence these masses arise and also to bear in mind the anatomical division of the gland into lobes which are constant. The excellent study of Lowsley has crystalized our knowledge upon this subject so that we are in a position to declare that the division of the prostate into a posterior, a median, and two lateral lobes is correct, bearing in mind the occasional persistence of an anterior lobe which ordinarily disappears in fœtal life, and the more or less frequent occurrence of detached groups of glands, such as the subcervical group described by Albarran. The disagreement of Tandler and Zuckerkandl with this classification is, I think, more apparent than real, for it seems to me to depend simply upon a definition of the extent of the median lobe which they regard as including what Lowsley has shown to be the lateral lobes. The distinction does not seem to me important. Recent work makes it abundantly clear that the adenomatous masses, ordinarily referred to as hypertrophy, arise from the median lobe, the lateral lobes, and occasionally from the subcervical glands and a persistent anterior lobe. There is no evidence that they ever arise from the posterior lobe, and this should be appreciated if we are to get any clear understanding of the tissues to be traversed in attacking the masses and the amount of tissue actually removed in any given operation.

Anatomical considerations. Though I regret to have to take this association over ground which is largely or wholly familiar, I feel required to point out the different nature of the covering of these adenomatous

masses when they arise from different portions of the gland. Thus, the masses occupying the lateral lobes are covered posteriorly by the posterior lobe and do not here come in contact with the capsule of the prostate. Laterally they lie against the true capsule of the prostate, or, as Mr. Thompson Walker calls it, the sheath. Superiorly they abut upon the median lobe and in the absence of development of this lobe upon the muscular structures of the bladder neck. Mesially they are covered only by mucous membrane and by the stretched and atrophied capsule of the prostate, *from which they cannot be separated by dissection even after removal from the body.*

The mass arising from the median lobe is covered posteriorly by the posterior lobe and as its overgrowth takes it backward it comes to a greater or less extent in contact with the muscular structures of the bladder neck and the bladder wall itself. Laterally it abuts upon the lateral lobes. Anteriorly and superiorly it is, like the lateral lobes, covered only by the thin atrophied mucous membrane from which it is inseparable.

Relation of the posterior lobe to the urethra. It will be remembered that the posterior lobe is by definition that portion of the prostate which forms its posterior surface and lies wholly behind the ejaculatory ducts. It thus forms the floor of the urethra from the apex of the prostate to the verumontanum and from this point ceases to touch the urethra and runs backward in a narrowing triangle behind the median lobe. The sides of the urethra are throughout formed by the lateral lobes, and the floor of the urethra from the veru to the bladder orifice is formed by the median lobe. This accounts for the horse-shoe form of many adenomatous prostates removed from above, in which the sides of the horse-shoe are formed by the lateral lobes while the bow is formed by the median lobe. It further accounts for the well recognized fact that in enucleating the prostate by the intra-urethral method, whether from above or from below, the mucous membrane tears on the sides at the junction of the floor and the lateral wall up to the verumontanum, at which point it tears transversely following the line of the median lobe. Upon this depends the undoubted fact that

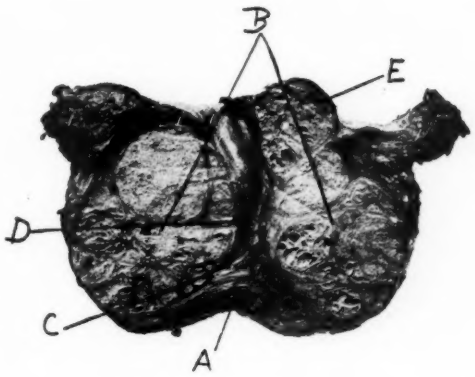


Fig. 3. Section of same prostate as Fig. 1, about 1 cm. further back than Fig. 2. Note the extreme thinness of the covering of the adenomatous mass B at point D. The chance of removing mass B and leaving behind the portion E is obviously great if approached from below by Young's method.

by this method of enucleation the posterior lobe and its structures, particularly the ejaculatory ducts, are left undisturbed.

WHAT PORTIONS OF THE PROSTATE ARE REMOVED BY THE METHOD OF ENUCLEATION WHETHER FROM ABOVE OR FROM BELOW?

It seems to me important to take up this question inasmuch as our English brethren, particularly Mr. Freyer and Mr. Thompson Walker, still apparently cling to the idea that the whole prostate is removed. This was specifically stated by the latter at the meeting of L'Association Internationale d'Urologie in London, 1911. A careful investigation of the material upon which he bases this claim singularly fails to establish the fact. It will, I think, be generally admitted that the removal of the whole prostate must involve the removal of the posterior lobe. If the posterior lobe is removed, clearly with it must be removed those portions of the ejaculatory ducts which lie between the verumontanum and the capsule. These structures are strikingly absent not only in the specimens described by Mr. Thompson Walker but in all the specimens to which I have had access, a not inconsiderable number. The specimens herewith presented show in section that these ducts lie wholly behind the adenomatous masses of the

lateral lobes and the median lobe. As the posterior lobe is never involved in the process, the line of cleavage necessarily passes in front of it, and it is from this, the posterior lobe, that the process described by Mr. Freyer as the "shaking free" of the masses takes place. It is probably not necessary to pursue the discussion of this point further since the absence of ejaculatory duct structures from the specimens is sufficiently conclusive proof. What actually occurs in these operations of enucleation is that the adenomatous masses in the lateral and median lobes are shelled out from the capsule of the prostate on the side, from the muscular structure of the bladder neck above and from *the posterior lobe, the old so-called surgical capsule, below.*

A COMPARISON OF THE TISSUES INVOLVED IN PROSTATECTOMY BY THE SUPRAPUBIC ROUTE AND BY THE PERINEAL APPROACH OF YOUNG

Dr. Young has described his operation as conservative prostatectomy and it is therefore proper to inquire in what respects it is conservative as compared with other methods. I believe that this term "conservative" was intended to apply chiefly to the conservation of the ejaculatory ducts and to the avoidance of injury to the structures involved in the nervous mechanisms pertaining to potency. In the suprapubic method of approach the masses are reached by breaking through the mucous membrane in the urethra and enucleating the masses from the posterior lobe and that portion of the urethra lying in front of the verumontanum which is left intact. The median portion is separated from the grasp of the muscles of the bladder neck, which lie in a relation to it varying with the the amount and direction of the growth. The posterior lobe structures are not disturbed and frequently not even uncovered. In Young's operation these masses are approached from behind through oblique incisions intended to avoid injury to the ejaculatory ducts. The incisions traverse the whole thickness of the posterior lobe which has been referred to under the misleading term of the surgical capsule and this is of necessity a destructive procedure. Furthermore, the position of the ejaculatory ducts is not as constant as has been often believed, for their position is influenced by the irregularities of growth of the lateral masses and they may lie close together on the posterior surface of the gland or be considerably separated, especially as they approach the upper border of the gland. For most of us, the avoidance of the ejaculatory ducts is at least highly speculative and I have yet to see any operator other than the father of this operation executing the procedure in a way which seemed to me at all likely to lead to anything properly regarded as a conservative result. In my hands it could only be described as highly destructive. But the most difficult part of the operation is still to come. Dr. Young declares that the lobes are enucleated from inside of their capsule but it must be remembered that these lobes are covered by nothing properly described as a capsule but only by mucous membrane and a little fibrous tissue which adheres to the lobes with extreme intimacy. If these lobes are to be truly enucleated they must be enucleated from under the mucous membrane. This I do not believe to be an anatomical possibility as I have tried to remove this mucous membrane many times after the lobes had been taken out from above and have found it impossible even sitting quietly at the dissecting table. I present herewith specimens and illustrations which seem to me to show the absolute fallacy of the conception. (Figs. 1, 2 and 3.) What does take place, as a matter of fact, in the hands of those who attempt the operation of Young is the enucleation of greater or smaller portions of these lateral and median masses from within the masses themselves, the amount of adenoma left behind depending upon the lines of cleavage within the mass and the experience and dexterity of the operator. The adenomatous tissue left behind vitiates the results of the operation in two ways. In the first place, according to its amount and position it reproduces more or less exactly the form of the obstructing tumor present before operation, which may flatten down considerably as the hollowed out cavities within it contract. It thus remains largely a matter of accident whether the relief to the patient is large or small. In the second place, a hardly

less serious objection is that from the adenomatous tissue left behind new masses are formed and the patient has no assurance that his obstruction is permanently at an end. I do not wish to convey the idea that prostatectomy as done by Young is not a benefit to his patients; but the operation as described by him I believe to be faulty in conception and inefficient in execution in the hands of all but its distinguished author.

Since the term "conservative" has been applied to this method of perineal prostatectomy, it seems to me that we are entitled to inquire of what the conservation consists. I have always assumed that the term was intended to apply to the conservation of the ejaculatory ducts, the remaining prostatic tissue, therefore the posterior lobe (miscalled surgical capsule) and the nerve fibers traversing the prostate and ending in the neighborhood of the verumontanum. If I have correctly understood the author, it must now be abundantly clear that no such result can be expected from this operation. The attack traverses directly the only important part of the remaining prostatic tissue. The avoidance of the ejaculatory ducts is, to put it mildly, extremely problematical, and it is far more sound to describe it as destructive than as conservative of these tissues. The operation by intra-urethral enucleation to a large extent avoids this damage and particularly when carried out from above may leave them almost wholly intact. I desire, however, to repeat what I have elsewhere said, that I think altogether too much stress has been laid upon the conservation of these structures. The end and object of the operation of prostatectomy is to remove the obstruction, and no minor issues should blind us to the supreme importance of its absolute accomplishment. Since, however, stress has been laid upon this point it seems to me proper to point out that in this regard it cannot be accepted as accomplishing the end.

If I have made myself clear in what I have said above, it necessarily follows that for anatomical reasons which cannot be controverted, prostatectomy must be done by some form of intra-urethral enucleation, and it remains only to discuss whether the results are most satisfactory when this is undertaken from above or from below. Having regard only for the functional results, I believe that the suprapubic route is far superior. By this method it can be declared with certainty that if the patient survives the operation, the function of the bladder will be restored practically to normal. By the perineal method of attack certain more or less objectionable sequelæ not infrequently occur. The approach is such that the muscular control is jeopardized, particularly in the case of large masses; and a certain number of cases of incontinence, more or less partial, is almost certain to result. Fistulæ of various kinds always have, and I believe always will, occasionally result, those communicating with the bowel being the least common but most serious.

For these reasons it seems to me that in dealing with the type of prostate in which the obstruction results from the formation of adenomatous masses, the suprapubic route has a clear advantage over the other methods of attack.

BILATERAL URINARY CALCULI[1]

By DANIEL N. EISENDRATH, M. D., Chicago

UNDER the above heading are included all cases in which calculi are simultaneously present in both halves or sides of the upper urinary tract, i.e., in the kidneys and ureters. The combinations in which bilateral calculi are most frequently encountered are: (a) in both kidneys; (b) in both kidneys and in one or both ureters; (c) in the kidney of one side and the ureter of the opposite side; (d) in the kidney of one side and the ureters of both sides, and, finally (e) in the ureters of both sides. These various combinations are shown in a diagrammatic manner in Fig. 1, and X-ray tracings of practically all of the varieties are shown in Figs. 2 to 10, taken from cases observed at the Michael Reese Hospital during the past few years.

Calculi on both sides of the urinary tract present problems quite different at times from those of one side only. The questions which arise when one of the five previously mentioned combinations is recognized before operation vary greatly according, first, to the functional condition of the two kidneys, and, second, as to whether calculous anuria is present or not.

There is one feature of the bilateral cases, which, although not more typical of calculus formation on both sides than of unilateral disease, is at least of sufficient importance to be first considered. This is the tendency to the re-formation of calculi after removal from one or both sides. Under the head of treatment in this paper I will report two cases of this kind, and speak of occurrences in detail.

Another interesting fact in regard to bilateral calculus formation is the frequency with which the condition is found. A review of the few articles thus far published and a glance over our own large number of cases at the Michael Reese Hospital shows that in about twenty per cent of all patients in whom calculus formation has been found, either clinically (X-ray examination, etc.), or at operation, the condition was a bilateral one.

DIAGNOSIS

Clinical Pictures.

Cases of bilateral calculus formation are usually seen presenting one of the following clinical pictures:

1. Cases showing the ordinary calculus (ureter or renal) symptoms on one side, but radiographs show calculi on both sides.

2. Cases with pain or other symptoms alternately on one side or the other, and radiographs show calculi on both sides.

3. Cases presenting definite symptoms of calculus simultaneously on both sides. (These are comparatively rare.)

4. Cases seen either during an attack of calculous anuria or giving the history of transitory attacks of anuria with calculus symptoms in the intervals.

The well-known clinical fact that the pain may be referred to the side opposite to which the renal calculi are located must not be overlooked in connection with the first three groups. Aside from these clinical pictures there is absolutely nothing characteristic of calculi in both sides of the urinary tract to permit a differentiation from cases where they are located in one half of the tract only, i.e., in the kidney or ureter of one side.

For practical purposes then, one may divide cases of bilateral calculi into (a) those presenting the familiar symptoms of renal or ureteral calculi, and (b) those seen during an attack of calculous anuria. The cases of Class a present themselves under one of the clinical pictures just described (1, 2 and 3). The cases included in Class b, i.e., calculous anuria, present such an entirely different clinical picture as to demand special recognition.

CALCULOUS ANURIA CASES

The majority of surgeons do not agree with the views of Kümmell that an anuria is rarely due to the reflex inhibition of the secretory activity of one kidney when the opposite ureter is blocked by a calculus. Kümmell,

[1] Read before the Chicago Surgical Society, February 7, 1913. See discussion page 257.

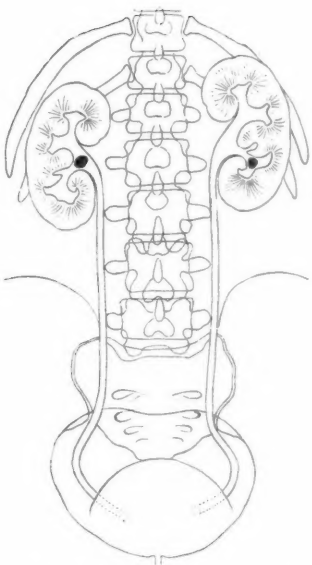


Fig. 1. Combination No. 1. Calculi in both kidneys.

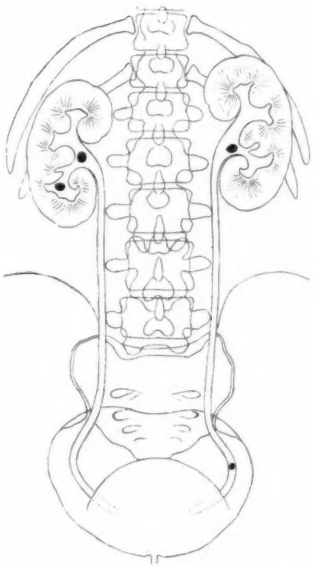


Fig. 1. Combination No. 2. Calculi in both kidneys and one ureter.

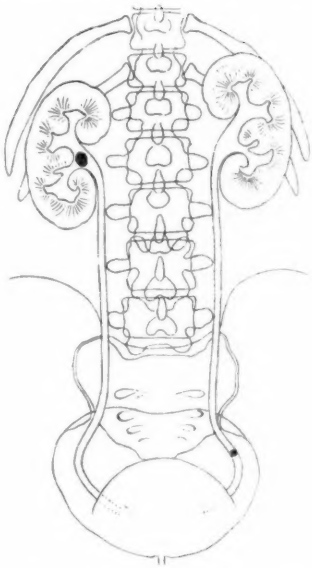


Fig. 1. Combination No. 3. Calculi in right kidney and left ureter.

in other words, does not believe in a true reflex anuria, but rather that when anuria exists both ureters are in all probability blocked. When anuria follows an operation for calculus on one side, the opposite kidney has either been damaged by the anæsthetic or its ureter is blocked or there is a congenital lack of development of the opposite kidney present.

Calculous anuria is more likely to develop in cases of bilateral calculi than in unilateral cases. Kümmell has had six cases of anuria in fourteen cases of bilateral calculi. Watson and Cunningham give the following conditions under which anuria develops when calculi are present, and it is well to remember these when attempting to make a diagnosis in any case of anuria. These conditions are:

1. When the ureter of a solitary kidney is blocked by a calculus.

2. When both ureters are simultaneously blocked.

3. When one ureter is blocked and the other kidney is not developed.

4. When the fused ureter of two kidneys or the single ureter of a fused kidney is blocked.

5. When one ureter is blocked and the opposite kidney is reflexly suppressed.

The last-named class of cases has been discussed above and the view of Kümmell that a true reflex anuria does not exist is disputed by many surgeons. Watson has shown by clinical records and autopsies that Kümmell's view does not hold for all cases.

As a rule, cases of calculous anuria are seen before uræmic symptoms have appeared. In a few cases death has occurred without uræmic symptoms and it is impossible to predict the time of the onset of uræmic symptoms. The average time of their appearance in sixty-two cases collected by Watson was between five and six days. In four it was as short as twenty-four hours and in fourteen cases it was between the tenth and sixteenth day.

The diagnosis, to be of any service, must usually be made during the "period of tolerance," i.e., between the appearance of the anuria and the onset of uræmic symptoms. The importance of such an early diagnosis is clearly shown in the statistics of Watson. In 205 collected cases, 110 were treated expectantly with 80 deaths (72.7 per cent mortality);

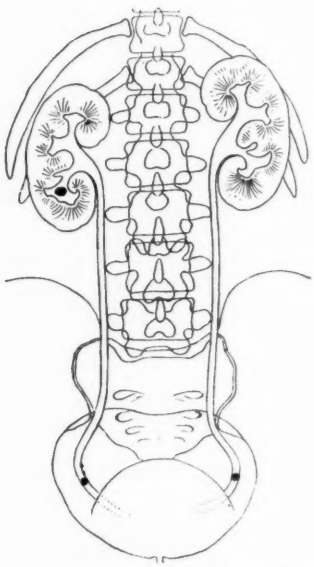


Fig. 1. Combination No. 4. Calculi in one kidney and both ureters.

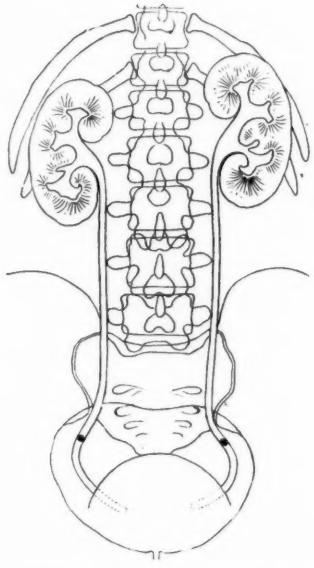


Fig. 1. Combination No. 5. Calculi in both ureters.

95 cases were operated with 44 deaths, i.e., 46.3 per cent mortality. If time and the local circumstances permit, an X-ray is invaluable, but this cannot always be done, and the side to be operated on must depend, according to Watson, on the history as to the side where the renal colics were felt, and upon the results of palpation. Tenderness and enlargement are the most reliable local signs, but are not always present. Of course, the ideal method of diagnosis in cases of anuria would be to take a radiograph and thus locate the seat of obstruction. This is, however, not always possible, and one is dependent upon the clinical history and local findings alone.

VALUE OF X-RAY

In every patient suffering with unilateral symptoms of either renal or ureteral calculus it is our duty to include both sides in our pictures. One can accomplish this by the use of a single plate, large enough to include the entire urinary tract, as Caldwell and others do, or by employing separate plates for the upper and lower portions of the urinary tract. Haenisch and many other German radiographers, and Lange, of Cincinnati, preter to employ five plates, one for each kidney, one for the lumbar and iliac portions of each ureter, and, finally, one to include the pelvic portion of both ureters and the bladder. The majority of radiographers who make a single exposure for the entire urinary tract omit the use of the Albers-Schoenberg compression apparatus. Dr. Frances Turley, our radiographer at the Michael Reese Hospital, has obtained the most satisfactory pictures by the use of compression aided by the loofah pad of Sträter, as described by the writer in a previous article. We find that in the ordinary individual both kidneys and the lumbar portions of both ureters can be readily included in a single plate, aided by compression and the loofah pad. The iliac and pelvic portions of both ureters and the bladder are then included in a second picture, also aided by compression, etc. We have even been able to secure the shadows of both kidneys themselves in the majority of cases, if the patient is not too stout, and if the alimentary tract has been thoroughly prepared.

The larger my experience in the interpreta-

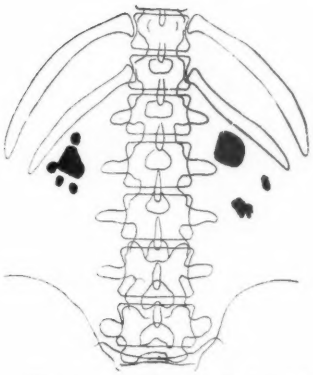


Fig. 2. Tracing of shadows in Case 1 (Eric H.) before first operation.

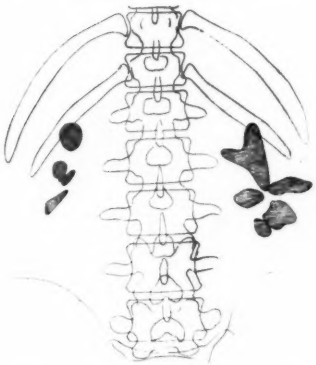


Fig. 3. X-ray tracings of Case 1 after my first operation. Note recurrence of multiple shadows in both kidneys.

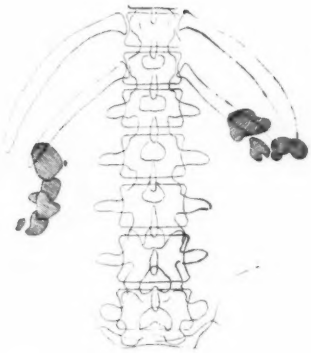


Fig. 4. Case 1. After second operation by Dr. Berger showing shadows of second recurrence.

tion of radiographs of the urinary tract becomes, the more I am convinced of the necessity of exclusion of shadows of gas or solid material in the intestines by careful preparation of the patient for at least twelve hours before the pictures are taken.

In this connection I need hardly call attention to the ease with which one can be led astray by finding an undoubted calculus shadow on one side and then assuming without further examination (by lead wire, etc.) that a shadow seen on the opposite side must necessarily be due to a calculus. Every condition giving rise to extrarenal or extraureteral shadows must be excluded, as in the ordinary diagnosis of calculus. Caution in this direction only increases with experience, and many are the pitfalls unless one bears in mind that an extraneous shadow may be present both in the case of undoubted unilateral or bilateral calculous formation.

TREATMENT

The question of operative interference varies according to whether the patient is seen during an attack of anuria or not. In the ordinary case, i.e., when anuria is not present, there is considerable difference of opinion as to whether the calculi are to be removed at one sitting or at intervals of four to six weeks. A second question to be answered is whether one is justified in removing an infected calculous kidney when the condition is a bilateral one. The majority of surgeons believe that it is best to operate upon the worst side first and then operate upon the other side six to eight weeks later, unless anuria occurs either during the interval, as the result of a reflex suppression of the other kidney, or a blocking of the opposite ureter. This occurred in one of Cabot's cases on the eighteenth day after the first kidney had been opened for the removal of calculi. The worst side is determined by ureteral catheterization and the functional tests. Watson believes one should attempt to remove the calculi from both kidneys at one sitting under certain conditions. He operates first on the side which gave the last symptoms. If this first kidney to be operated upon is seen to be of insufficient capacity to sustain life, he operates at once on the opposite kidney. If the first kidney is in good condition he operates on the second side after an interval. I believe that the position taken by Watson is the most rational one and was the method pursued in the cases of Dr. McArthur and the writer.

The question of nephrectomy depends entirely upon whether the opposite kidney is functionally incapacitated or not, and whether its ureter is likely to be blocked or not following the removal of the worse kidney.

When calculous anuria is present, operation should be performed as soon as possible. One cannot stop to determine the functional

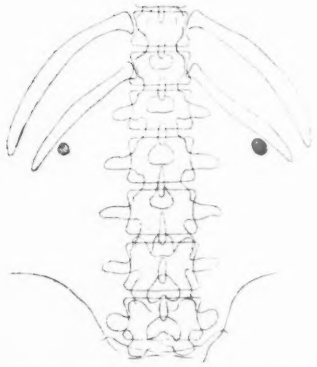


Fig. 5. X-ray tracings of Case 2 after first operation by Dr. McArthur, showing shadows due to first recurrence.

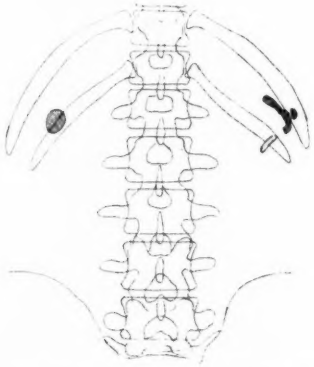


Fig. 6. Multiple calculi in left kidney and single large calculus in right kidney. Dr. Braunwarth's case.

capacity and often not even to take an X-ray. The side should be chosen where the kidney is enlarged and tender, and if the calculus on this side seems to be the cause of the blocking of the ureter, further operation on the opposite side should be deferred to a later time. Even if the cause of the ureteral obstruction has been removed on one side, but the kidney looks as if it were of insufficient functional capacity, it is best to operate on the opposite kidney at once, i. e., at the same sitting.

The treatment of recurrences presents a new problem, well illustrated in the two following cases:

CASE 1. Eric H., aged twenty, was first seen by me in October, 1908, having been referred by Dr. Mortimer Frank. At the age of fifteen he began to have pain alternately over the right and left renal regions. During the first four years the pain had been chiefly felt over the right kidney, but in the year preceding my first examination the pain was usually localized in the back, over the left kidney. In July, 1907, the pain, which had been quite constant and of an aching character, became quite severe over the left kidney and radiated along the ureter of the same side. This attack lasted three days, and was accompanied by chills and fever. He passed a small amount of "gravel" and blood during this attack. The patient showed me a radiograph of the left kidney, taken by another radiographer, which showed a number of typical stone shadows. This picture had been taken by a radiographer who, although thoroughly competent, was satisfied at that time (1908) to take a radiograph of only the kidney or ureter to which the clinical symptoms pointed. I immediately insisted upon having a bilateral radiograph taken, both from the standpoint of thoroughness and because his pain had been referred for four years alternately to the right and left kidneys. The radiograph of the entire urinary tract showed (Fig. 2) a number of typical shadows scattered over so wide an area that one could readily diagnose either a pyonephrosis or many dilated calyces filled with calculi. On October 30, 1908, the left kidney was exposed and fourteen phosphatic calculi were removed. They varied in size from a pea to a small marble. Most of the calculi were found lying in cavities which were evidently dilated calyces scattered throughout the kidney. Several calculi were in the renal parenchyma of the upper and lower poles. It had not been possible to estimate the functional capacity of the opposite kidney by ureteral catheterization before operation. Owing to the presence of a fair amount of apparently good parenchyma at both poles and the lack of knowledge of the condition of the other kidney, a nephrectomy was deemed inadvisable. About eight weeks later, i.e., January, 1909, the opposite (right) kidney was exposed and seven phosphatic and pure uric acid calculi removed. The condition of this kidney was even worse than on the left side, so that it would have jeopardized the patient's life to have removed either kidney. The calculi were found in the renal pelvis and in pockets lying just beneath the fibrous capsule of the kidney, with very little intervening healthy parenchyma. The patient recovered rapidly, but the urine continued to remain turbid and contained a large number of colon bacilli and pus corpuscles. For one and a half years after the removal of calculi from both kidneys by the writer, the patient worked steadily as a lens grinder for an optical firm. Owing to the recurrence of pain over both kidneys, he consulted Dr. Berger, of Chicago, who had radiographs of both kidneys made (Fig. 3). I am indebted to Dr. Berger for the courtesy of including them in the records of the case. These second radiographs showed an even larger number of shadows scattered

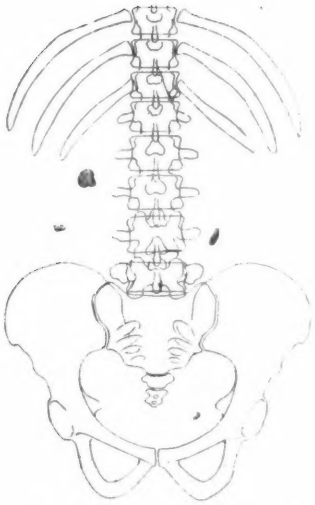


Fig. 7. Case 2. Showing shadows due to second recurrence.

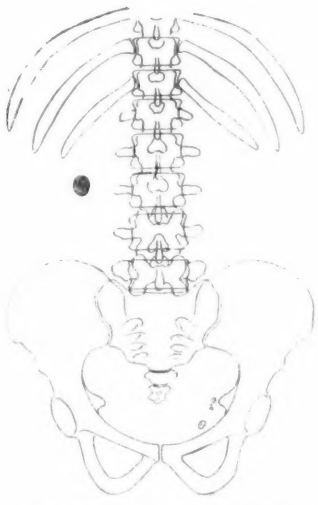


Fig. 8. Calculus in pelvis of right kidney and multiple calculi in opposite ureter. Drs. Steele and Carr's case.

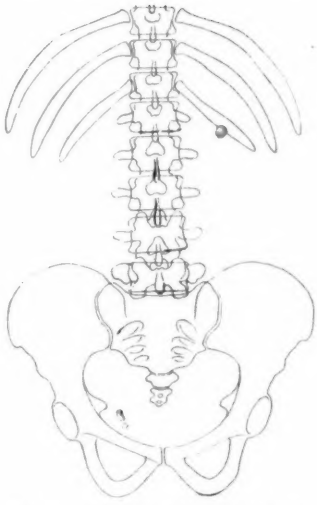


Fig. 9. Bilateral calculi left kidney and right ureter. Dr. Crofton's case.

throughout both kidneys than I had found at my operation. Phosphatic material, partly formed into calculi and partly found as a tenacious débris, was removed at two sittings by Dr. Berger from both kidneys in 1911. The patient again made a rapid recovery from both of these nephrotomies, but the urine remained as turbid as after the previous operations. In order to gratify my curiosity, the patient consented to have a third series of radiographs of both kidneys made early in 1912 (Fig. 4). These pictures showed so many deep shadows over each kidney that it seemed scarcely possible for the patient to have so few symptoms. He is at the present time (December, 1912) apparently enjoying the best of health, unconscious of the fact that the second bilateral recurrence is even more marked than after the first operations.

So far as I can learn, this is the first case in which the recurrence of calculi in both kidneys has been so thoroughly controlled through repeated radiographic examinations. One can scarcely ascribe the shadows seen before the second nephrotomies preformed by Dr. Berger and those now present to the fact that the calculi were overlooked, since both Dr. Berger and I made a careful but futile exploration of every portion of both kidneys for further calculous deposits during our respective operations.

This case illustrates the necessity of making a guarded prognosis in regard to recurrence in cases of bilateral calculi where (a) one cannot remove either kidney lest the other one be unable to do the work of both organs, or (b) where the pathological changes in the kidneys are such as to favor the formation of calculi if the original infection still continues.

CASE 2. Through the courtesy of Dr. L. L. McArthur, to whom I am greatly indebted for the privilege, I am able to add a second case of recurrence of calculi in both kidneys, in spite of two attempts at thorough removal of the calculi. The patient was a woman of twenty-seven who had first complained of severe pain over the right kidney in 1903, which had recurred at intervals for four years. She then began to have similar attacks of pain over the left kidney. The radiographs taken in March, 1908, when she first consulted Dr. McArthur, were negative. Owing to the predominance of the pain over the left kidney, a nephrotomy on this side was performed. A calculus, the size of a pigeon's egg, was removed from the left renal pelvis. A number of smaller calculi, which were found in the calyces of the same kidney pelvis, and one calculus in the parenchyma, were removed at the same sitting. In June of the same year (1908) a perinephritic abscess was opened through the nephrotomy (left) incision made earlier in the year. The kidney was explored at this operation, but no calculi found. In February, 1909, the right kidney was opened and several calculi removed through a pyelotomy incision. One of the calculi filled the entire pelvic outlet and extended up into two of the calyces. A second calculus, the size of a marble, was felt in the

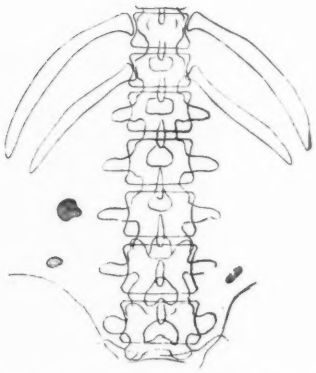


Fig. 10. Several calculi in right kidney and single pipe-like calculus at left uretero-pelvic junction.

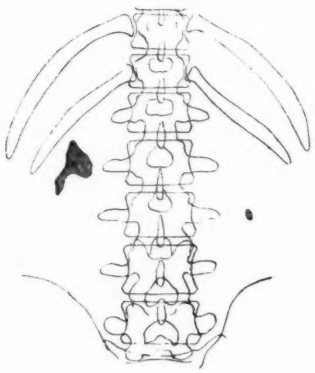


Fig. 11. Large coral-like calculus in right kidney and small calculus in pelvis of left kidney. Drs. McArthur and Eisendrath's case.

upper pole of this right kidney, and removed through a nephrotomy incision. About two years after the removal of the calculi from both kidneys she began to have pain over the right kidney and local evidences of a perinephritic abscess. The radiographs (see Figs. 5 and 7) taken in April, 1912, when her pain recurred, showed a typical stone shadow in the lower pole of the right kidney, a large stone shadow in the lower pole of the left kidney, and also a shadow in the pelvic portion of the left ureter. All of her symptoms pointed to the right kidney only as the seat of the trouble, since the left kidney was neither tender nor enlarged. It was only by a strict adherence to our rule of a radiographic examination of the entire urinary tract that attention was called to the fact that the recurrence of calculi had taken place on both sides.

On April 4, 1912, Dr. McArthur opened the right perinephritic abscess and evacuated a large amount of pus. The kidney was enlarged to double its normal size and the kidney was drained through its convexity after removal of a uric acid calculus, the size of a bean, from its lower pole. It was deemed inadvisable to remove the kidney. About three weeks later a calculus, the size of a pea, was removed from the pelvic portion of the left (opposite) ureter by an incision through the vaginal wall.

Legueu[1] has had two recurrences in four bilateral cases. This is the only reference which I can find of recurrence in bilateral cases. Dr. Farr, of Minneapolis, has kindly furnished me with the history of a bilateral case of recurrence. In 1905 he removed a calculus from the pelvic portion of the right ureter. In 1906 a calculus was removed from the left kidney. Later in the same year a calculus was removed from the right kidney and from the right ureter at the point where the calculus was removed in the previous year. In 1907 calculi were again removed from both kidneys.

These cases of Legueu, Farr, McArthur, and my own present a problem not hitherto considered and the danger of such recurrence both in respect to diagnosis and method of operation.

In the H.R. case (No. 1) of Dr. McArthur, and in the E.H. case (No. 2) of the writer's, calculi were removed most thoroughly from both kidneys or ureters at two sittings in each case. A glance at the X-ray tracings of my patient will show that almost as many calculi are present now as before the first or second operations. The question of why these calculi should have re-formed is necessarily so intimately associated with the entire problem of calculus formation in general that it would take us beyond the scope of this article to attempt to do more than simply mention it here. We know comparatively little about the underlying causes of or the conditions under which calculi form in the urinary tract. That infection plays a very prominent rôle is generally acknowledged, but it is not the only factor. In one of my own cases (E.H.) a chronic colon bacillus infection, with seven calculi in one and fourteen in the other kidney, was found in a boy of eighteen, and it is fair to assume that it

[1] Ann. d. mal. d. org. génito-urin., Par., 1907.

had existed for many years before being seen by the writer. His bacillus coli infection has now persisted for the past six years, and has undoubtedly played the most vital part in the recurrence or re-formation of the calculi in both kidneys. In Dr. McArthur's case the conditions, in a young woman, were quite similar.

We, however, see calculus formation on one or both sides in so-called aseptic cases, so that infection is not necessarily the only factor to be considered. Undoubtedly, disturbances of metabolism alone play equally as important a part as infection in the precipitation of urinary salts and the formation of calculi. The problem of why one person should have calculi form primarily and another only secondarily, i.e., when infection is present, is still unsolved. One must grant, of course, that the calculi formed when infection is present are usually of a different nature, usually mixed phosphates and carbonates. But why should they be deposited at one time and not at another?

This question is not only of theoretical but of great practical importance. We have known for centuries that bladder calculi frequently recur if the infection continues. We are just beginning to recognize the fact that under similar conditions calculi will re-form in the upper urinary tract and we must be prepared to have this occur as it did in Dr. McArthur's and my own cases, unless we can get rid of the underlying factor, namely, the infection. Only one who has seen kidneys such as those of my E.H. case, where it was necessary to save both organs because neither one by itself was capable of maintaining life, can appreciate the apparent impossibility of eliminating the infection factor. We must in the future follow our cases of unilateral as well as of bilateral calculous disease, in order to determine the frequency of recurrence and shape our prognosis accordingly. In other words, we must not expect permanent relief through operative measures, if the original conditions favoring calculus formation persist.

In addition to the above two cases, we have had five other bilateral cases at the Michael Reese Hospital. One was not operated upon because the patient had a carcinoma of the uterus (Fig. 6). In one case (Fig. 8) the renal calculus was removed, but the patient died some months later of a senile intercurrent disease before the opposite ureteral calculi could be removed. In one case (Fig. 10) no operation was performed, owing to an advanced pulmonary tuberculosis. In a fourth case (Fig. 11) the calculi were first removed from the right kidney by Dr. McArthur, and after an interval of three months an attempt to remove a left-sided calculus by the writer through a pyelotomy incision was followed by such severe bleeding as to require removal of the kidney. This case has been reported elsewhere as showing one of the dangers of pyelotomy. The right remaining kidney continues to show negative shadows and the patient was three months pregnant at the time of writing this article and has been delivered of a normal healthy child since article was written.

THE INFLUENCE OF THE THYROID GLANDS ON PREGNANCY AND LACTATION [1]

By WILLIAM M. THOMPSON, M. D., Chicago

IT IS generally accepted that the thyroids are influenced to a marked degree by menstruation, pregnancy, and lactation, but our knowledge thus far is chiefly clinical and has not yet approached that degree of accuracy necessary to a comprehensive understanding of the subject.

It is my purpose to correlate a certain amount of this clinical evidence together with some reports of laboratory workers, and, by adding a few experiments of my own, to try to furnish a confirmatory contribution to this theory.

The statement of Dr. Miles F. Porter that "in certain invertebrates the gland is a sexual organ and empties through a duct into the genital tract," suggests the idea that if it were possible to establish an anatomic connection in man or higher mammals a strong basis for the theory would be established. It is germane, therefore, to trace back the history of the work in this department, and the investigation carries us to the palæontologists who have found this connection to exist in some of the prehistoric ostracea. I shall take the liberty of quoting from Gaskell (one of the best known observers in this field). In his chapter on the thyroid glands of the palæostrachia, he says: "The thyroid gland is derived from the uterus of the palæostracian ancestors. In one animal (the palæostraca) the foremost pair of mesosomatic appendages forms the operculum which always bears the terminal generative organs and is fused in the middle line. In many forms, essential in Eurypterus and the ancient sea scorpions, the operculum was composed of two segments fused together — an anterior, which carried the uterus, and a posterior which carried the first pair of branchiæ. In another animal (ammocœtis) the foremost segments of the mesosomatic or respiratory region immediately in front of the glosso-pharyngeal segment are supplied by the facial nerve and are markedly different from those supplied by the vagus and glosso-pharyngeal, for the facial supplies two segments fused together, the anterior one, the thyroid gland, and the posterior hyoid, carrying the first pair of branchiæ.

Just as in Eurypterus, the fused segment carrying the uterus on its internal surface forms a long median tongue which separates the most anterior branchial segments on each side, so also the fused segments carrying the thyroid forms in ammocœtis a long median tongue, which separates the most anterior branchial segments on each side.

Finally, and this is the most conclusive evidence of all, the thyroid gland of ammocœtis is totally unlike that of any other of the higher vertebrates, and indeed of the adult form, the Petromyzon itself, but it forms an elaborately complicated organ, which is directly comparable with the uterus and genital ducts of animals, such as scorpions.

The relationship which has been known from time immemorial to exist between the sexual organs and thyroid gland in man and other animals, and has hitherto been a mystery, without any explanation, may possibly be the last reminiscence of a time when the thyroid glands were the uterine glands of the Palæostracan ancestors. *Changes in the sexual organs cause changes in the thyroid glands.* The activity of the thyroid begins with puberty and ceases with the menopause. Drs. Goodall and Conn, among many others, have reported cases to verify this statement. Dr. Hertzler, after reviewing twelve cases, says that pelvic lesions and exophthalmic goiter coexist, and that the pelvic lesions frequently precede hyperthyroidism. Crile speaks of the influence of exophthalmic goiter on sexual neurasthenia. Goodall and Conn note further that increased sexual function is a frequent cause of hypertrophy of the thyroid. Also that chronic inflammation of the uterine appendages, especially of the tuber-

[1] Read before the Chicago Gynecological Society, February 21, 1913, See discussion page 264.

cular type, causes increased thyroid activity; and that the thyroid and ovary stand in relationship not as compensators, but as neutralizers. It is therefore easy to understand that changes in thyroid glands may influence changes in the sexual organs or vice versa.

Hyperthyroidism as a factor in the production of sexual changes has been known for several centuries, but it was not until 1859 that Charcot, in his articles published in 1859 and 1862, brought the knowledge of the day into a logical and tangible form. Aran in 1865, in a paper before the Académie de Médicin, laid great stress upon the influences of hyperthyroidism in effecting disturbances of menstruation. Goodall and Conn cite a number of authors in defence of this theory, agreeing with others that it is the ovary that is directly influenced. It has been shown that there are two secreting structures in the ovary. The first, the corpus luteum, which develops periodically and has a special relation to pregnancy, in that during pregnancy it develops enormously, and in addition, in order to meet the demands upon the ovary, every other Graafian follicle develops a large ring of lutein cells around it.

The second are the interstitial cells of the ovary, and they are more uniform in their secretion, and of longer life than the sexual life of the woman. It has been further shown that the secretion which most influences the thyroid is from the interstitial cells of the ovary. For, if intercourse or any repeated congestion cannot cause the ova to ripen at irregular periods, it does increase the interstitial secretion, and hence thyroid hyperactivity follows.

Pinard records nine cases in which exophthalmic goiter showed unmistakable connection with ovulation. Stowe reports a case of Basedow's disease associated with pregnancy that led to a fatal termination. He believes it to be a rare complication of pregnancy, and that its relation thereto is shrouded in mystery.

PROPORTION OF FEMALES TO MALES WITH HYPO AND HYPERTHYROIDISM

According to Osler, the proportion of females to males afflicted with thyroid disease is about 8 to 1. The majority of cases of exophthalmic goiter occurs between the ages of 16 and 40.

Porter states that thyroid disease is about five times more prevalent in women then men. This statement is corroborated by Drs. Marne and Lenhart, who maintain that starting from puberty active hypertrophy is more common in females. The clinical evidence is estimated to be from 3 to 1 to 6 to 1. After puberty colloid glands are more common in females for the reason that hyperplasias are more common. Rübsamen states that he found 34.2 per cent of 718 women in the Maternity at Berne had goiter, that is, 246, while at Dresden there were only 29%.

The behavior of the thyroids during pregnancy is an interesting subject about which but little is known. My attention was definitely attracted to this obscure department of physiology by a patient who came to the clinic at St. Joseph's Hospital. She appeared to be about four months pregnant. She had an hypertrophied thyroid, but no symptoms of thyroidism. Two weeks later she returned and announced that she had visited another hospital and had the largest lobe removed. I believe she neglected to tell the surgeons of her pregnancy. I observed her closely for about three weeks and noticed that the uterus steadily decreased in size until it was almost normal and as firm as a non-pregnant organ. She reported no bleeding. Later she was curetted of some atrophied decidua and villi. In six months this woman again became pregnant. The remaining thyroid was much enlarged up to the fourth month. She had a normal labor and the thyroid subsided.

It is not possible to enumerate the literature of thyroids and pregnancy in a paper of this character, so I will confine myself to citations from some of the more important reports.

Ciullo concluded that the suprarenal capsules, the pituitary body, and the thyroid became hyperæmic and hypertrophic during pregnancy. Second, the parathyroids show no increase in their functional activity during pregnancy, but that this occurs during the puerperium.

In a later report he states that "the thyroid hypertrophies, softens, and becomes more vascular; microscopically its capillaries are seen to be dilated and full of red globules. Second, its functional activity is indicated by its secretion (a) of granules and (b) of colloid substance."

The toxæmiá of pregnancy and thyroidism has proven a fertile field for investigation. Dr. Charles H. Mayo recommends thyroid extract for the extreme vomiting. Dr. Porter expresses the opinion that the toxæmia of pregnancy and puerperal infections were probably often due to thyroid activity.

Dr. George Gray Ward in his first article concludes that: (1) The thyroid gland is in all probability concerned in promoting nitrogenous metabolism. (2) That the gland normally hypertrophies during pregnancy. (3) That failure of the gland to hypertrophy during pregnancy may result in the various forms of toxæmia of pregnancy. (4) And in Graves' disease during pregnancy he recommends the administration of thyroid substance. Subsequently, in discussing the same subject he makes two classifications: (*a*) cases, having no Graves' disease, but without sufficient thyroid secretion to promote the increased metabolism in the liver made necessary by pregnancy; (*b*) cases associated with Graves' disease.

For the *a* group he recommends thyroid substance; for the *b* group he says it is essential to determine whether Graves' disease is a condition of hyperthyroidism or of hypothyroidism. In the former he recommends rest, ice pack, and the crysto-toxic serum of Beebe and Rodgers for the later thyroid substance.

In a critical review of the work on exophthalmic goiter and pregnancy, labor and the puerperium, Dr. Clifford White classifies the subject under three heads: (1) The influence of child-bearing on the goiter. (2) The influence of the goiter on child-bearing. (3) The condition of the child born of exophthalmic mothers.

After quoting writers from Actins (1567) to the present time, who reported cases of exophthalmic goiter occurring during pregnancy, also those reporting cases of Graves' disease accompanying the toxæmia of pregnancy, he concludes that there is little doubt that Graves' disease strongly predisposes to sterility.

If pregnancy takes place, premature labor, and antepartum hæmorrhage occasionally occur; pregnancy is an important factor in the disease, and on the whole makes it worse. Patients may improve toward the end of pregnancy, but are again made worse by labor, and, as I myself have observed, also by lactation.

Dr. Reuben Peterson declares that enlarged thyroid is not uncommon in pregnancy, and especially with eclamptic convulsions.

B. V. Beck had 420 patients apply for relief from thyroid symptoms during the course of their pregnancy. In 260 of this group there had been preceding symptoms of hyperthyroidism. At the end of the fifth month the signs of thyroid hyperfunctioning subsided except in five of the ten cases of pronounced exophthalmic goiter. His experience warns that no operative measures should be attempted, not even artificial delivery in severe exophthalmic goiter with persisting thymus. The treatment can be only internal and directed against the thyrotoxicosis.

Dr. Chas. B. Reed cites Lang's work, which extended over four years. His results were "that a hyperplasia of the thyroid gland is physiologic in pregnancy. Pregnant animals (cats) require for the maintenance of their health larger thyroids than the non-pregnant. After the total extirpation or the removal of more than four-fifths of the thyroid in pregnant animals, tetany occurs, but is promptly relieved by the administration of thyroidin.

"Lang examined 133 pregnant women and in all but 25, 3 of which were doubtful, he demonstrated thyroid enlargement at some period of the pregnancy. In the 18 cases wherein the gland was not enlarged there was absolutely demonstrated pregnancy kidney and albuminuria."

THE INFLUENCE ON THE FŒTUS OF MATERNAL GOITER

Rübsamen details nine cases of congenital goiter in which the mothers had goiter. Dr. Church delivered an exophthalmic mother of

twins; one died, and the other was epileptic. There was epilepsy in the family.

Dr. F. J. Poynton described a case of a mother with Graves' disease being delivered at the age of 25 years of a child that at the fourth month was a typical cretin.

Ochsner and Thompson show photographs (Schmauch's case) of a child with Graves' disease whose mother also suffered from this affection. Schmauch says that in most instances there has been no transmission of this condition from mother to child, also that in a large proportion of cases abortion is the result in exophthalmic goiter.

Porter avers that goiter in the mother often produces bone deformities in the offspring. Dr. Barry characterizes the thyroid gland at birth as almost solid and containing little colloid. Ballantyne quotes Svehla, who states that the fœtal thyroid does not contain any substance to accelerate the pulse.

THE INFLUENCE UPON LACTATION

Hertoghe believes that thyroid given to lactating women increases the flow of milk, and Bang states that the active principle is excreted by the milk.

Morse and Cathala report a case where a marasmatic goitrous child improved rapidly when thyroid was administered to the nurse.

Bramwell noted symptoms of hyperthyroidism in a child each time that thyroid extract was given to its mother, who was suffering from Graves' disease, which had developed during pregnancy. Ciullo concludes that both glands (thyroid and parathyroid) have an important effect upon lactation, citing Almagha's experiments, who removed the thyroid apparatus from young puppies, they showing no ill effects while being suckled, but when this was suddenly stopped the animals died.

The foregoing is, I believe, sufficient to establish the theory as a legitimate field for further inquiry.

I shall terminate my paper with some references to the laboratory evidence. While the works of Drs. David Marine and C. H. Leonard concern chiefly the pathology and the relation of iodine to human thyroids, nevertheless they have reported interesting experiments on three pregnant bitches, which I take the liberty of summarizing.

Bitch A-17 gave birth to normal pups after one lobe had been removed and iodine administered. The fifth pup was born dead.

In A-104, after a litter of normal pups were born, the dog again become pregnant, and one and two thirds of the thyroid lobes were removed, which were pure colloid. In this second litter the pup's thyroid was slightly enlarged and histologically in a state of early glandular hypertrophy.

In A-112, immediately after impregnation, one and two thirds lobes were removed which histologically were in a state of moderate glandular hyperplasia. Of the two pups born, one died at birth, and the other — which was given iodine — lived.

Dr. Halsted, of Johns Hopkins, is said to be the first to have produced and to have recognized the experimental production of congenital thyroid hyperplasia in dogs. His observations made in 1888 and 1889 include three litters of goitrous pups from different bitches. All those bitches had their thyroids removed (from 1 to 1⅔) prior to impregnation. L. Alguier and L. Thienveny published the results of 11 experiments relative to the condition of the ovaries of bitches having undergone total extirpation of the thyroid and parathyroid apparatus.

Experiments 10 and 11 were on pregnant bitches. In 10 a total thyroidectomy with partial resection of a parathyroid was performed. Two months later the bitch died, and the uterus was found to contain two young ones about term. In 11 the bitch underwent unilateral thyroidectomy; 6 weeks later she bore 6 young ones, which died within 48 hours.

Experiment 12 was a bitch with voluminous breasts containing plenty of milk. Operation was followed by torpor, anorexia and albuminuria, and death on the twenty-second day, showing that thyroidectomy is particularly badly borne during lactation.

The other 8 experiments were made to show the influence of thyroidectomy on the ovary, which, they say, scarcely seemed to be affected either in its structure or in its evolution. They report that clinically "the unfavorable influence of thyroidectomy upon different manifestations of sexual activity has appeared to us very clear, conforming to the results already found by other experimentalists. The menstrual periods appear less frequent and are of particularly short duration. Conception is more difficult to obtain."

In May, 1911, I began experimenting on pregnant bitches with the object of ascertaining the effect of disturbances of the thyroid apparatus during the height of sexual activity. In all, 9 dogs were operated on. In 5 dogs one lobe of the thyroid was removed. In two one lobe was removed and the remaining thyroid tissue badly bruised and ligated and in one both lobes and some parathyroid were removed. In one both lobes were removed; and one lobe and hypertrophied thyroid were removed from another dog and implanted in the site of the excised gland.

Dog No. 1. Black and white fox terrier, supposed to be 8 weeks pregnant. May 8th, 1911, removed right lobe of thyroid. May 10, condition good; wound healthy. May 15, condition good. May 17th, five puppies were born; condition good; milk abundant. May 22, dog and puppies well. May 27, dog and puppies well; wound healed. June 3, showing milk abundant. June 10, dog and puppies well. June 15, dog and puppies well; milk abundant.

Dog No. 2, in which both lobes were removed, died on the table, leaving 8 to be considered.

Dog No. 3. White fox terrier, supposed to be pregnant about 8 weeks. May 26, 1911, removed right and left lobes of gland and some parathyroid tissue. May 27, dog appeared sick. May 28th, slightly better; refused food, drinks water. May 29th, dog very sick; trembling and rigidity. May 30th, dog's condition very bad; difficulty in moving; tremors; five puppies were born. Milk glands soft and flabby. May 31, dog worse; 3 puppies found dead; no milk in glands. June 1st, dog and remaining puppies found dead.

Dog No. 4. Black-and-tan, operated May 30, 1911. Removed right lobe of thyroid and bruised left lobe. May 31st, dog's condition bad; takes water but no food. June 1st, dog stands with difficulty, tottering; on attempting to walk, trembling; bowels move; refused food, but takes water and sugar. June 2d, dog very ill; wound discharging; refused food; drinks a great deal; much urine. June 3d, dog very ill; puppies were born dead; wound discharging. June 4th, dog dead.

Dog No. 5. Vigorous female mongrel, operated July 15, 1912. Left lobe removed. July 17th, condition good; began feeding. July 18th, condition the same; bowels moved. July 19th, condition good. July 21st, wound discharging. July 22d, wound opens somewhat; condition good. July 24th. the same. July 25th, wound still discharging. July 26-27, dog in good condition. July 28th, five puppies born; breasts contain abundant milk. July 29th, dog runs about and barks a great deal; puppies nursing. July 30th, dog still angry; four puppies found dead. July 31st, dog and puppy well; plenty of milk. August 1-2, the same. August 3d, dog well; puppy dead. Post-mortem on puppy. Liver crushed.

Dog No. 6. Adult female mongrel, supposed to be pregnant and near term. July 26th, removal of left lobe; considerable hæmorrhage; traumatized remaining thyroid and parathyroid in controlling hæmorrhage. July 27th, dog appears ill; trembling; refused food; drinks water with sugar. July 28th, stands and walks with difficulty; tremblings; wound healthy; refuses food, but drinks. July 29th, dog very ill; refused food; frequent urination. July 30th, dog very ill; worse. July 31st, dog and one puppy found dead. Owing to the hot weather no post-mortem was possible.

Dog No. 7. Large, vigorous black-and-tan, supposed to be about 8 weeks pregnant. Operated the first week in October. Both lobes removed; one lobe and an hypertrophied thyroid taken at the same sitting from another dog and implanted in wound. Dog made a good recovery. Two weeks later dog escaped from pen and was lost.

Dog No. 8. Fox terrier said to be about 8 weeks pregnant. October 23, 1911, removed right lobe; good recovery. Nov. 8, 1911, four puppies born; milk abundant.

Dog No. 9. Mongrel. Removed right lobe on January 7, 1912. January 8, condition good. January 14, puppies born; glands contain abundant milk.

In summarizing these we find that dogs No. 1, 5, 8, and 9, in which one lobe of the thyroid was removed with no accidents, gave birth to normal puppies and had abundant milk. That dog. N. 4, in which the remaining thyroid was bruised, had a stillbirth and died. That dog No. 6, which had a severe hæmorrhage during the operation, in the control of which there was sufficient injury to the remaining thyroid and parathyroids, equivalent to a ligation of the artery, had one puppy born dead and succumbed herself. That dog No. 3, on which double thyroidectomy was performed together with the removal of some of the parathyroid tissue, had symptoms of tetany; gave birth to five living puppies, but appeared to have no milk, and that the dog and puppies all died in a few days. It is unfortunate that dog No. 7 escaped, as it would have been interesting to observe the effect of thyroid transplantation on the puppies.

It will be seen from the above that the removal of one thyroid gland has comparatively little influence on pregnant dogs or their pups after birth, but that the removal of

one half, with injuries sufficient to destroy the function of the remaining thyroid and parathyroid tissues, is followed by tetanic seizures and death of mother and puppy. That the total removal of the thyroids, with some parathyroid tissue, is followed by trembling, rigidity, and that after the birth of the puppies the milk was scanty, and later the mother and puppies succumbed.

CONCLUSIONS

1. That the thyroid gland, situated as it is in the neck, should have any sympathy with sexual functions if it was originally a gland concerned with digestion, is, to say the least of it, extremely unlikely; but on the contrary, likely enough if it originated from a glandular organ in connection with the sexual structures of the palæostracean ancestors.

2. That there is clinical and experimental evidence of its connection with the sexual system of man and higher mammals through its secretions, in that a lack of thyroid secretion influences sexual activity adversely; that sexual activity, whether it be physiological or pathological, causes a hyperactivity of the thyroids, and that this hyperthyroidism constitutes an index to the toxæmia of pregnancy to counteract which the thyroids raise their antitoxic protective power.

3. That there is abundant clinical evidence in support of the theory that what is termed a physiologic hyperactivity of the thyroid is a valuable safeguard against the toxæmia of pregnancy.

BIBLIOGRAPHY

AETIUS AND GEULLEMEAU. Quoted by Jenks. Am. J. Obst., N. Y., 1881, p. 5.

ALQUIER AND L. THIENVENY. Comp. rend. Soc. de Biol., Par., 1909, lxvi, 217.

BALLANTYNE. Antenatal pathology (Fœtus), p. 166.

BANG. Berl. klin. Wchnschr., December, 1897.

B. V. BECK. Beitr. z. klin. Chir., 1912, lxxx, 1.

BEEBE. J. Am. M. Ass., 1907, xlix, 1155. J. Exp. Med., November 1905, 487; 1906, 661. Tr. Ass. Am. Physicians, 1906, 548.

BERRY. Diseases of Thyroid, p. 45.

BRAMWELL. Lancet, Lond., 1899.

CHURCH. Obst. Tr., Edinb., xxxii, 160.

CIULLO. Ann. di Obst. la Gynec. Med., 1910, March, October and November.

G. W. CRILE. Bull. M. and S. Faculty Maryland, Baltimore, 1911, July.

GASKELL. The Origin of Vertebrates from the Palæostracia.

GOODALL AND CONN. Surg., Gynec. & Obst., 1911, xii, 457.

HALSTED. Johns Hopkins Hosp. Rep., 1896, i, p. 399.

ARTHUR E. HERTZLER. J. Am. M. Ass., 1911, lvii, no. 26, p. 2076.

HERTOGHE. Sem. Med., 1896.

LANGE. Jahrb. f. Gynäk. und Geburtsh., 1898–9.

MARINE AND LENHART. Arch. Int. Med., 1909, iv, pp. 253 and 440.

CHARLES H. MAYO. Surg., Gynec. & Obst., 1912, xiv, 363.

MOSSE AND CATHALA. Acad. de Med., 1898.

OCHSNER AND THOMPSON. Surgery and Pathology of Thyroids and Parathyroids, p. 193.

WILLIAM OSLER. System of Medicine.

REUBEN PETERSON. Phys. & Surg., 1909, xxxi, 547.

PINARD. J. Am. M. Ass., 1906, i, 151.

MILES F. PORTER. Am. J. Obst., N. Y., 1911, xiv, 781.

F. J. POYNTON. Quoted by White. J. Obst. & Gynec., Brit. Emp., 1911, xx, 3.

CHARLES B. REED. J. Am. M. Ass., 1899, June 24.

RODGERS. J. Am. M. Ass., 1911, Sept. 2.

W. RÜBSAMEN. Arch. f. Gynäk., Berl., 1912, xcviii.

GEORGE SCHMAUCH. Am. J. Obst., N. Y., 1910, October.

HERBERT MARION STOWE. Am. J. Obst., N. Y., lx, 1909.

GEORGE GRAY WARD. Surg., Gynec. & Obst., 1909, ix, 617.

CLIFFORD WHITE. J. Obst. & Gynec. Brit. Emp., 1911, xx, 126.

DEPARTMENT OF TECHNIQUE

CHOLECYSTOSTOMY BY OBLIQUE FISTULA[1]

By JOSEPH WIENER, M. D., New York City
Adjunct Surgeon, Mount Sinai Hospital

DURING the past twenty years the writer has been following the gamut of surgery of the biliary system. In the old days we had cholecystostomy; at first in two stages, on account of the frequency with which the peritoneum was infected in the one stage operation. As our experience increased and the incomplete results of the two stage operation became more and more apparent, the one stage cholecystostomy became the operation of choice. Owing to faulty technique, we frequently saw biliary fistulæ persisting for months and years. Then, about ten years ago, we began to do cholecystectomy on a large scale, and our results improved very much, but the mortality was high. But, in our enthusiasm at the good results obtained, the pendulum swung too far forward in favor of cholecystectomy. As has so often happened before in other procedures, the pendulum is again swinging somewhat backward, if we can call it backward, at least in certain cases toward cholecystostomy. Up to ten years ago the writer regularly did the old cystostomy operation. Then, for a few years, cystectomy was the operation of choice in more than seventy-five per cent of the cases. During the past six or seven years we have given considerable thought and study to this subject. We have long thought that if we could eliminate some of the drawbacks of cystostomy, by perfecting the technique of the operation, much good would result. Why? In the first place, we cannot deny that the gall-bladder has a function; and especially in younger subjects we like to keep all organs intact for future use. True it is that thousands of patients have had their gall-bladders removed, and are well and happy. We have ourselves contributed a fair number to these many cases, and in some of these cases we were personally very much interested in getting as good a result as possible. We have numerous such cases that have remained well for eight and ten years after removal of the gall-bladder. Nor do we wish to give the impression that we have given up doing cystectomy. However, all surgeons the world over are agreed that there is a higher mortality following cystectomy than following cystostomy. The difference in the percentage of mortality following these two operations varies considerably with different surgeons. The selection of cases and the personal preference of the surgeon no doubt color the figures. But every surgeon reporting a large number of cases has a decidedly higher mortality from cystectomy than from cystostomy.

What then are the drawbacks and objections to cholecystostomy, and why do we, or did we, so often remove the gall-bladder? The four chief drawbacks enumerated against cystostomy are: 1. Persistent fistula. 2. Post-operative pain and discomfort. 3. The re-formation of stones. 4. Cancer.

1. Persistent fistula. The only cases of persistent fistula after our method have been in cases of stricture of the cystic duct or empyema of the gall-bladder. We no longer do a cystostomy in these two classes of cases. In none of our other cases, except in one reported below, have we seen a persistent fistula. And in this one case we had to subsequently remove a stone which we had probably overlooked at the first operation. But it is only too true that we often did have persistent fistulæ following the old cystotomy and cystostomy operations. It was largely to overcome this that we have gradually developed the technique which we now employ with such gratifying results. In spite of errors made in our earlier cases and unnecessarily complicated technique, the average stay of our cases at the hospital during the past four years has been twenty-one days after operation. Of late, by simplifying our method of suture and materially lessening the amount of drainage, we are reducing the time to two and a half weeks. This we believe eliminates the question of persistent fistula.

2. Post-operative pain and discomfort. With the old operation we sutured the gall-bladder to

[1] Read before the Surgical Section of the New York Academy of Medicine.

the parietal peritoneum all around, and used numerous gauze packings besides. Much of the pain our patients formerly complained about for months and years was due to the extensive adhesions resulting from these two mistakes in technique, of which we, in common with most others, were often guilty. As we will point out in describing our technique, we no longer fasten the gall-bladder all around to the parietal peritoneum, and we are using less and less drainage. The result is that our patients are becoming more and more comfortable after operation.

3. *Re-formation of stones.* It is extremely rare that this takes place. If it does take place, we must not forget that it may take place in the stagnant bile in the ducts following the removal of the gall-bladder, as well as in a gall-bladder that has been left in situ. True, we have all had to do secondary operations on gall-bladder and ducts to remove stones, but in almost every one of these cases the stones had already been present at the first operation. In some cases they may have been high up in the hepatic ducts and inaccessible at the first operation. Occasionally we leave portions of a crushed stone, or detritus, that forms the nucleus for the growth of a stone. Such cases we have all observed, both after cystostomy and after cystectomy. Nor is it always of necessity the fault of the surgeon that a stone, or portions of a stone, is left behind. Many of these cases, especially if operated on during an acute attack, are not good operative risks. Often the anæsthetist will warn the operator that further procedure would be hazardous. Is it not better in such cases to desist from further search for stones — which may or may not be present — rather than endanger the life of the patient? But when all is said, the number of cases in which stones re-form in the gall-bladder, after all stones had been removed at operation, is extremely small. So small is it that some good observers declare that they have never seen a single case. And we must not forget that with patent ducts small stones that are left behind will often pass into the duodenum. Furthermore, in our technique, we are now irrigating the gall-bladder through the drainage tube daily after the fourth or fifth day. In this way we have several times washed out small stones that came down from the hepatic ducts following the operation. We have, in several cases of acute cholecystitis that were not in good condition, found the hepatic ducts packed full of small stones. To slit up the hepatic ducts in such cases in order to remove every stone is to court disaster. We have repeatedly cured these cases by milking out as many stones as possible, and irrigating the gall-bladder for ten days after operation. Of course we are now referring to acute cases in poor condition, where a prolonged operation will often mean the death of the patient.

4. *Cancer.* The danger of cancer developing in a gall-bladder containing an ulcer or stones is no doubt a real one, but the danger of cancer developing in a gall-bladder that no longer contains stones or ulcer is, we believe, a small one. In cases of gangrene or extensive ulceration of the gall-bladder we regularly do a cystectomy.

Choice of operation. It is not our purpose to compare cystostomy with cystectomy. Each has its field; but we believe that we have materially widened the field of cystostomy with a resulting lowering of the mortality rate. So much has been written of late on the indications for cystectomy that one is led to believe that there is hardly a unanimity of opinion on the subject. New growths, gangrene, extensive ulceration, empyema, stricture of the cystic duct, atrophy or marked hypertrophy of the gall-bladder, extensive pericystic adhesions—all these are rightly mentioned as indications for cystectomy. But there are a goodly number of cases that do not come under these categories. I shall not enumerate them in detail; but, from the case reports, a fairly good idea will be obtained as to the class of cases in which we perform our operation.

The cases that form the basis of this paper were operated on by the writer in the service of Dr. Howard Lilienthal, at Mount Sinai Hospital; and I am indebted to Dr. Lilienthal for his courtesy in allowing me to publish the cases. The details of technique we have gradually been perfecting over a period of more than five years. We will only report cases operated on since 1909, as, in the earlier cases, we were more or less groping in the dark. Even in the last three years we have made numerous changes in our procedure. We formerly used linen thread to suture the tube into the gall-bladder, but we now use only plain catgut. Linen, and even chromic catgut knots can and do form the nidus for the future development of gall-stones. A recent writer reports a secondary cystotomy at which he found three chromic gut knots in the gall-bladder, each one forming the nucleus of a stone. Until recently we sutured the gall-bladder to the parietal peritoneum. Not only is this a time consuming procedure, but it actually does harm by causing post-operative pain, due to extensive formation of adhesions. By now omitting this suture, we save considerable time—especially in obese subjects, the patient is more comfortable after operation, secondary

operations due to adhesions are rare, and, as there is no leakage by our method, no harm can result from not suturing the gall-bladder to the abdominal wall. In the old cystostomy operation, which is still done by some, this suture is essential.

Duration of operation. We firmly believe that the time consumed in operations on the biliary system is of the very greatest importance, both as regards morbidity and mortality. We have given this question much thought and study, and we expect to report thereon at greater length in a subsequent paper. Suffice it to say here that we have collected and studied a large number of fatal cases at the hands of different operators and that the mortality is high in operations of this nature which last more than an hour. When we consider that in these operations we have the liver and its ducts, portal vein, large mesenteric vessels, stomach, duodenum, diaphragm, and large nerve plexuses, exposed, is it any wonder that nature resents prolonged manipulations? There is scarcely another region of the body where it is so essential to work rapidly, and where slow and prolonged operating is so apt to do harm. In these operations, at the hands of various surgeons, not only have we noticed a higher mortality, but a much more stormy convalescence, more complications especially referable to the pleura and lungs, i. e., following prolonged operations on the biliary system. All this we noted several years ago. As a result we have striven continually to simplify our technique and to shorten the time of operation as much as possible. Not only do we work as rapidly as possible, but we have tried to so alter our technique that time would be saved. Doing away with the elaborate suture of the gall-bladder to the abdominal wall is a case in point. Another step forward has been the introduction of the gloved finger into the opening in the gall-bladder. Not only can we thus quickly explore the interior of the gall-bladder and often the cystic duct, but it aids materially in removing stones both from the bladder and ducts. We introduce the index finger of the left hand into the gall-bladder and with the right hand inside the abdomen we can often milk back stones from the cystic, common, and even at times the hepatic ducts, into the gall-bladder, and remove them. Since adopting this procedure, which we believe is not in general use, we have often saved the patient a choledochotomy or drainage of the hepatic duct. The dangers of choledochotomy, both primary and secondary, are too well known to need enumeration. And if, by our procedure, we occasionally are able to substitute a simple operation like cholecystostomy for a dangerous operation like choledochotomy, it surely is a great gain for the patient. As soon as the finger is removed from the gall-bladder it is swabbed off with tincture of iodine and the operation is proceeded with; it is not necessary to change the glove. Another advantage of the finger in the gall-bladder is that a new growth, or an ulcer, or a stricture at the neck of the gall-bladder, or in the cystic duct, can be detected.

Technique. Our usual technique is to carefully palpate the liver under deep anæsthesia. If the liver does not extend below the free border of the ribs our incision through the fibers of the rectus starts just below the free border. If the liver reaches further downward, we start our incision from a point opposite the lower border of the liver. If we are in doubt about the lower border of the liver, we begin with a very small incision well below the free border of the ribs. The object of all this is to save making an unnecessarily long incision. If the liver extends to the level of the umbilicus it is naturally not wise to start our incision at the free border of the ribs, as it would be several inches longer than necessary. The incision is carried through skin and anterior sheath of rectus, the fibers of the rectus are bluntly separated, and the posterior sheath of the muscle and the peritoneum incised. This first incision is always a short one and is used for exploration with two fingers. Then the incision is enlarged up or down and the gall-bladder and ducts carefully palpated. If the gall-bladder is distended, it is emptied with a syringe or a small trocar, after packings have been carefully placed around the gall-bladder. A small incision is then made into the gall-bladder near its fundus, at the site of the aspiration, the remaining contents squeezed out and at once mopped away. Then the gloved finger is inserted into the bladder, stones still remaining are removed, stones in the ducts are, if possible, milked back into the bladder and removed. A large new catheter or rubber drainage tube is then introduced into the gall-bladder, sometimes into the cystic duct or even into the duodenum (according to the suggestion of McArthur of Chicago). The incision is made into the fundus of the bladder so that when the bladder contracts the drainage tube will still be below the free border of the ribs. We now establish an oblique fistula by suturing the tube into the bladder, as we do in performing a Witzel or Kader gastrostomy. If the exposed area of bladder is long and narrow, we use the Witzel method of suture; if the area is wide and not very long, we suture according to Kader. The result

in either case is the same. We now use plain catgut exclusively for these sutures. If they have been properly applied we find that the tube is held very firmly, and cannot be displaced even by using considerable force. However, we usually pass one suture partly through the wall of the bladder and through the tube, to make doubly sure the tube will remain in place. We no longer suture the gall-bladder all around to the parietal peritoneum. Sometimes we pass one of the through-and-through chromic gut sutures that close the abdominal wall partly through the wall of the gall-bladder, but even this is not necessary. Very little drainage is required. We formerly used gauze packings around the bladder, but, with increasing experience, we found that in most cases a drain of rubber dam placed under the fundus of the gall-bladder and wrapped around the tube was all that was needed. We sometimes close the abdomen with three layers of sutures: plain gut for the peritoneum, chromic for the rectus and its sheath, and silk for the skin. Often we use only two layers: through-and-through number three chromic gut sutures to include all layers except the skin, with a few fine chromic sutures for the anterior sheath of the rectus, and silk for the skin. After the fourth day the gall-bladder is irrigated daily with saline or a weak astringent solution; sometimes we start this irrigation before the fourth day. We believe that these irrigations shorten the time of convalescence; they remove inspissated bile and small fragments or even complete stones. The drainage tube is connected with a bottle attached to the patient's bed. During the first few days the drainage is usually profuse, then soon becomes less. The first dressing is done on the seventh or eighth day, when the rubber dam drain is removed. We usually remove the tube between the tenth and fourteenth day, and are guided somewhat thereby by the character and amount of bile being drained, and also the general condition of the patient. The patient gets out of bed about the twelfth day and leaves the hospital, usually with a superficial sinus, about the twenty-first day. We have given up extensive gauze drains, as they are not necessary with our technique, and they undoubtedly delay convalescence. We have also found that if gauze or rubber dam drains are left more than a week after operation the healing of the wound will be delayed. This we believe is due to the development of a firm walled fistula which takes a very long time to fill in.

To get the best immediate as well as remote results, attention to all the apparently unimportant points we have mentioned is, we believe, essential. Letting the first dressing go until the twelfth day may delay the healing of the wound for several weeks. The same is true of using numerous gauze drains around the gall-bladder. Since we use very few drains our wounds are healing more rapidly. As regards the immediate result of operation, we consider the duration of operation of the greatest importance. Other things being equal, if we take a series of th se cases and subject them to operations lasting over an hour, we will have a higher mortality, a more stormy convalescence and more complications than if we perform quicker work. Many, if not most of these patients, are obese and they stand ether none too well. If we operate over an hour they are taking ether almost an hour and a half. This in itself is a very serious matter, aside from the prolonged operative procedure, with its exposure of important vessels and organs. We cannot too strongly emphasize our belief that time is a very essential factor to success in this work. We have computed the average time consumed in doing our cholecystostomy operation during the past four years, and found it to be less than thirty-nine minutes. In most of the cases we sutured the gall-bladder to the peritoneum. This takes several minutes, and we now dispense with it and thus shorten the time of operation still more.

In the following case the operation was done during an acute attack, and we believe the after-treatment was materially shortened by irrigations of the gall-bladder with weak solutions of tannic acid.

Fanny E., 45 years, admitted August 18, 1910. One year before she had had an attack of right hypochondriac pain with chills, fever, and constipation. These attacks had recurred frequently. Four days before admission there was a severe attack with vomiting and fever. There was moderate tenderness over the entire abdomen, especially in the right hypochondrium. The gall-bladder was found somewhat distended, the ducts free of stones, but adhesions around the cystic. The gall-bladder was aspirated, then opened, and many stones as large as cherry pits removed. The usual tube drainage was employed. Time of operation 21 minutes. Five days later the gall-bladder was irrigated and thick mucus washed out. Thereafter we irrigated daily with saline and weak tannic acid solutions. On the eleventh day the tube was removed and on the twentieth day the wound was healed.

Remarks. After operations for acute cholecystitis we are making it a practice to irrigate the gall-bladder daily after the third or fourth day, and we keep up these irrigations until the bile drained from the tube becomes perfectly clear. This is usually about the tenth or twelfth day after operation. We believe it is fair to assume that these irrigations with astringent solutions

do hasten to allay the inflammation in the gall-bladder, and thus shorten convalescence.

One of the most rapid cures we have had in these cases was the following:

Etta E., 21 years, admitted July 7, 1911. During the previous eighteen months she had had attacks of pain in the right hypochondrium, radiating to the back and right shoulder. Following the birth of a child, two months before admission, there had been frequent attacks of pain, with vomiting and chilly sensations. There was moderate tenderness in the right hypochondrium. T. 100.4°, P. 88, R. 22. At the operation we found some adhesions around the gall-bladder, which was not distended and contained two stones. The usual tube drainage was instituted. The operation took 35 minutes. The tube drained small amounts of bile for five days, and the gall-bladder was irrigated through the tube with saline solution. The first dressing was done on the eighth day and on the eighteenth day the wound was healed.

Remarks. We have often been able to send these cases home with a superficial sinus two and a half weeks after operation, but we think it rather unusual after any operation on the gall-bladder or ducts to have the wound completely healed in so short a time. We dwell on this fact particularly because some men object to cholecystostomy on account of the prolonged after-treatment. With the method we employ a prolonged after-treatment is a great exception. With the older methods of cholecystostomy, which we believe are still practiced by some men, a biliary fistula often persists for many weeks. As we have before remarked, it was largely to overcome this tendency to the development of a prolonged biliary fistula that we have been striving to devise a new technique.

We would again state that during the time we were doing this type of operation we were also doing cholecystectomy in cases which we considered suitable for this operation.

We believe that the operation which we practice has the following advantages:

1. Low mortality. 2. Low morbidity. 3. Retaining the function of the gall-bladder. 4. Rapid healing of the wound. 5. No danger of permanent fistula. 6. Ease of secondary operation, if one becomes necessary. 7. In cases of icterus, as there is not much dissection required, there is less danger of post-operative hæmorrhage and shock. 8. As there is no leakage around the tube, no gauze packings are needed, and in consequence the healing is rapid.

A GASTROSTOMY SUGGESTION

By EDGAR M. McGUIRE, M. D., Buffalo, New York
Attending Surgeon, Buffalo General Hospital

AFTER a moderate experience in this work the following conclusions seem to me justifiable: (1) There is no ideal method, judged by the number of different operations still in use. (2) All methods to produce an adequate valve are usually failures, because as contraction occurs, the original channel becomes an ordinary opening. (3) The mortality is higher than it should be for such a simple procedure. This last statement may be questioned by many, as their personal experience may be quite the reverse; but for the most part, however, these patients are in particularly desperate condition, because of starvation, and any operation is necessarily severe. In addition, as these cases are usually malignant, sutures do not hold well, and leakage is not infrequent. Finally when the stomach has markedly contracted, early feeding produces marked pull on sutures, and is a frequent cause of leakage.

In an effort to change this situation, I stumbled on a method which was new to me, although I do not doubt it has been used by others; namely, when the catheter is introduced into the stomach in any method, *pass it immediately through the pylorus into the duodenum.* This procedure enables one to proceed with feeding at once, without fear of tension on the stomach sutures. The catheter is borne well by the duodenum, as I have never seen any irritation due to it. In the course of three or four days the catheter is withdrawn into the stomach, the exact point of the catheter being previously marked.

The advantages of this method in desperate cases are self-evident. It not only offers a *safe* method for the immediate introduction of food, but also insures a certain and definite means of introducing salt solution or tap water into the circulation. It offers the same advantages to gastrostomy operations that McArthur's procedure gives to surgery of the biliary passages.

Whether this feature is new or not, I cannot say with certainty, but I have been unable to find any reference to it in the literature.

AIR IN THE VENTRICLES OF THE BRAIN, FOLLOWING A FRACTURE OF THE SKULL

Report of a Case

By W. H. LUCKETT, M. D., New York City

THERE may and probably have occurred just such accidental conditions as is hereinafter described, but if so, they were never recorded in medical literature. Rawling, in his "Surgery of the Skull and Brain," speaks of "surgical emphysema" resulting from fractures involving the frontal, ethmoidal, and mastoid sinuses. We venture to publish this case as the first on record of air in the ventricles of the brain, diagnosed as such before operation, found to be so at operation, and lastly proven to be true at autopsy.

E. K., 47 years old, machinist, was admitted to my service at the Harlem Hospital November 24, 1912, with the following history: Patient was struck by a trolley car and thrown to the pavement, receiving a laceration of the scalp. On admission temperature was 97.8°, pulse 72, and respiration 28.

Physical examination. White male, 47 years old, weight about 140 pounds, well nourished and developed, conscious and rational. Pupils react equally to light; right subconjunctival hæmorrhage. Head: Lacerated wound over right eyebrow, connecting with circular fracture of frontal bone just above the orbital ridge. Mucous membranes of good color; tongue covered with bloody fluid (probably cerebrospinal fluid). Skin: Ecchymosis in eyelids; contusions over left knee; laceration left eyebrow.

November 24, 1912, spinal lumbar puncture shows bloody fluid; no organisms on smears, but fluid slightly turbid. Blood pressure, right arm 115 mm., left arm 110 mm.

Diagnosis of fracture of the skull was made and was confirmed by two X-ray plates by Dr. W. H. Stewart (Fig. 1). The patient was prepared for immediate operation, but he cleared up so quickly that we decided to observe him for awhile. On the fourth day he was sitting up in bed; on the seventh day he was out of bed; on the eighth day he was walking around, and was discharged December 5, the twelfth day, at his earnest request, against our advice, and after signing a release. One week later, December 12, he was readmitted to my service at the Harlem Hospital, with the following history:

Three weeks ago he was struck by a car and brought to this hospital, where he remained until a week ago. Since his discharge he has had severe headaches and occasional vomiting attacks. He became dull and listless a few days after leaving the hospital, not taking any notice of his surroundings, etc. For the past few days he has not spoken when spoken to, although he understands, and has read the newspapers up until yesterday. There is a laceration over right eye.

Physical examination. White male, adult, 47 years old, 5 feet 4 inches, 140 pounds; poorly developed and nourished, semiconscious and irrational; lying quietly in dorsal decubitus. Ptosis of right upper lid. Tongue has heavy brown coat, tremulous. Throat negative. Heart sounds normal but somewhat distant; percusses within normal limits; no murmurs, no thrills. Arteries not palpable. Pulse regular in force and rate (66); compressible. Lungs: Prolonged respiration and increased breathing sounds over right base posteriorly; no râles. Abdomen normal. Liver: Upper border, sixth rib in midclavicular line; lower border not felt. Spleen and kidneys not felt.

Skin lacerated over right supraorbital region; slightly infected. Depressed fracture of skull right frontal region; other bones and joints show no signs of fractures. Muscles poorly developed and nourished. Lymph nodes: Inguinals palpable. No abdominal nor cremasteric reflexes; no Babinski. Sexual organs, external, negative.

Mentality slow and at times is aphasic; understands what is said but is not able to articulate; follows directions. Writes unintelligently. When asked his name, could or would not answer; when asked if he could write his name he nodded his head affirmatively. When given a pencil and pad and directed to write his name, he wrote the word "dagerous" irregularly and out of alignment. When asked what "dagerous" meant he looked at it and rewrote "dagerous" a second time, and then immediately wrote "dangerous."

Neurological examination by Dr. Wm. Leszynsky, 1 p. m. December 14. Patient is conscious and answers questions and obeys commands intelligently; cerebration slow; inclined to lapse from time to time to a condition of mental confusion; no aphasia (was aphasic at 11 a. m.); no disturbance of speech; no astereognosis. Tremor of tongue and hands. Pupils react equally, normal. Subconjunctival hæmorrhage in right eyelid. Facial innervation and motility of tongue normal. No tenderness on percussion over skull. No rigidity of neck. Upper extremities normal; no rigidity or paresis. Lower extremities show no paresis or rigidity, but resistive to examination. Both knee jerks+, right++. Right extensor plantar (Babinski) response (inframalleolar). Occasional spontaneous dorsal flexion of great toe. Left normal.

Diagnosis. Increased intracranial pressure, probable abscess.

Blood count December 15, 1912, shows: leucocytes, 15,900; number of cells counted, 100; polymorphonuclear, 86 per cent; lymphocytes, 8 per cent; large mononuclear, 6 per cent; small lymphocytes, 1.10 per cent. Urine clear; faintest trace of albumin; microscopically negative.

Ophthalmoscopic examination, December 15, by Dr. M. Cohen. External ocular examination normal, both eyes; slight subconjunctival hæmorrhage in right temporal quadrant. Right fundus: Veins enlarged and tortuous; central vein markedly dilated over disc and also at exit from nerve. Arteries slightly contracted. Disc borders indistinct due to marked œdema. Left fundus: Veins corkscrew in appearance, with marked dilation (principally at entrance). Arteries contracted. Disc borders indistinct due to marked œdema and swelling. Suspicion of retinal hæmorrhage. Unable to give a distinct location, as patient is unable to fix eyes for any length of time.

Diagnosis. Bilateral optic neuritis indicative of intracranial pressure (etiological factor?).

Fig. 1. The arrows marked on plate indicate the location of the fracture: the outer vertical plate of the frontal sinus is driven directly backward, smashing against the inner plate. Careful examination will show a linear fracture of the inner plate continuous with a fracture of the orbital plate. Note no changes in the soft parts.

X-ray pictures (Figs. 2 and 3), December 14, by Dr. W. H. Stewart, showed the ventricles enormously dilated with what was probably air or gas. Patient not having improved, but apparently getting worse, it was decided to do a cranial decompression.

Operation, December 16. Because of larger dilation of the right anterior horn we decided to do a right subtemporal decompression operation and to tap the ventricles. An incision 3 inches long was made vertically, curving slightly backwards over the temporal bone, through skin, fascia, muscle, and periosteum. Periosteum elevated and a ¾ inch trephine opening made. The bone was very thin. The dura did not bulge and was not particularly tense. No fluid escaped on incision of dura or pia, and a slight meningitis was noted. A needle was then passed into the anterior horn of the lateral ventricle and the removal of the trocar was followed by two or three quick spits of air and fluid and then clear cerebrospinal fluid to the amount of 8 cc. The dura was then sutured with No. 0 catgut; periosteum, muscle, fascia, and skin sutured. No drainage.

Because of the presence of a slight meningitis, the large quantity of fluid, and the presence of air in the ventricles, we determined to drain them, thinking that the patient would surely get up an ependymitis if indeed he did not already have it. Accordingly the patient was now turned over on the table, face down, and a suboccipital operation more or less along the lines suggested by Haynes was performed. An incision 4 inches long, from just above the occiput to just below the level of the foramen magnum in the median line, was made through to the occipital bone, which was trephined and rongeured to the

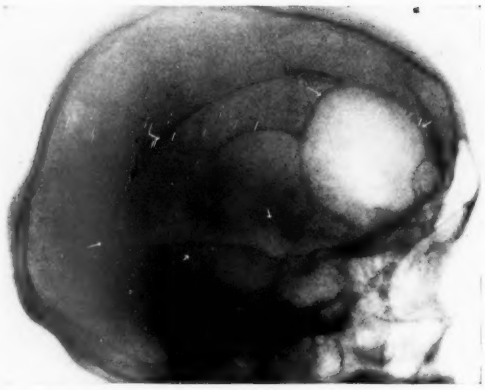


Fig. 2. Lateral view. The arrows outline the distended ventricles. The large round white shadow is the right anterior horn.

foramen magnum. The bone was exceedingly thin. The dura was incised and then the pia into the cisterna magna, and immediately there escaped considerable clear fluid, generously admixed with bubbles of air. A small piece of twisted rubber tissue was inserted for drain. Fascia, muscle, and skin sutured. Wound dressed.

The patient did remarkably well for four days after operation. December 17, the day after operation, temperature highest, 99.5°; pulse 84, respiration 22. Patient conscious and perfectly rational, but complained of some dizziness.

There was considerable discharge of clear fluid from the suboccipital drainage on the second and third days after operation. Blood pressure both arms 118 mm.

December 19, patient was in fine condition for the major part of the day. At 7 p. m. he suddenly took a turn for the worse; temperature shot up to 107°; an enormous amount of fluid escaped into dressings from suboccipital wound. Patient died at 9 p. m.

Laboratory reports. Eight cubic centimeters of clear, colorless, limpid fluid from tapping of anterior horn of right lateral ventricle; Benedict reaction for sugar (one hour) negative. Globulin reaction (Nogouchi) negative. Smears from sediment show no organisms or leucocytosis. Cultures show no growth in 24 hours; no growth in 48 hours. Wassermann reaction positive.

Report of autopsy on E. K., performed by Dr. Otto Schultze at the Harlem Hospital, December 20, 1912. Body of slight build, adipose scant, weight about 140 pounds. Right side of forehead, extending from eyebrow upward and slightly outward, a wound two inches long, partially healed, under which is found a depressed fracture of outer wall of right frontal sinus, circular in contour, about 2 cm. in diameter, with its center depressed 1 cm. below level of margin. Inner wall of frontal sinus presents a linear frac-

ture extending posteriorly through the right orbital plate and directed slightly inward.

Right temporal region, sutured wound of operation, under which is found an oval opening of the skull directly over the course of the right middle meningeal artery, also operative opening through the dura mater.

Linear sutured wound in median line from external occipital protuberance, about 4 inches long, with rubber tissue drain protruding, from which light reddish thin fluid slowly drips. Opening in base of skull just above foramen magnum, with drainage opening through dura and arachnoid into upper region of the cisterna magna.

Skull was opened for removal of the brain, the body lying upon chest and abdomen and the head hanging over the edge of the table. The posterior margin of foramen magnum and the arches of Atlas and Axis were removed with bone forceps. The entire area thus disclosed was found clean and absolutely free from blood clot beneath the dura mater, and free from all evidence of pressure (no flattening of surface of brain) or compression of base of cerebellum upon foramen magnum.

The upper spinal cord and medulla were dissected out from below upwards, the spinal dura was cut from the anterior margin of the foramen magnum and the cerebral dura severed in the line of the saw-cut, and the tentorium cerebelli cut from its attachment to the temporal bones and clinoid processes.

The skull-cap, containing the entire brain and stump of the spinal cord, was removed, the vessels and nerves being cut at the foramina of exit, from below forward.

The base of the right frontal lobe was found adherent to the dura over the fractured right orbital plate. These adhesions were carefully separated and disclosed a linear tear of the dura mater over the fracture of the right orbital plate, already described as communicating with the right side of the frontal sinus through the fracture in its posterior wall. The surface of the base of the right frontal lobe within the area of adhesions showed a soft yellowish red laceration.

The skull-cap, containing the brain, was submerged in a vessel of water, and on raising the stump of the spinal cord, air bubbles emerged from the foramen of Magendie; and when the extremities of the temporal horns of the lateral ventricles were incised, air bubbles emerged from them. The brain was removed from the skull-cap and bisected in the median plane. No blood was found in the ventricles.

The right half of the brain, with the lateral ventricle empty and opening on its median surface, was placed in water with the median surface downward; and on turning its base upward, air bubbles emerged through the laceration at the base of the frontal lobe, showing a communication with the anterior horn of the lateral ventricle.

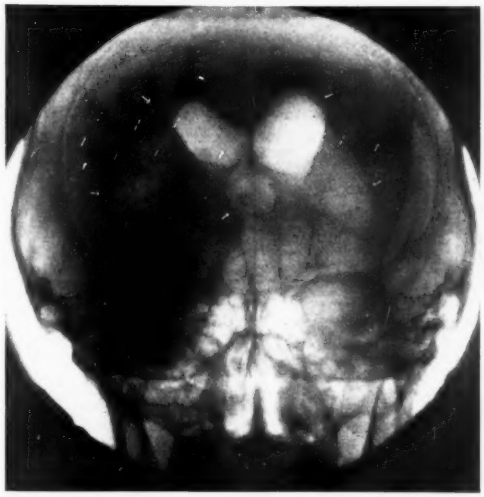


Fig. 3. Antero-posterior view. Two lateral ventricles distended with air. Small round white shadow just between and below is the third ventricle also distended with air. Arrows indicate the position.

The pia mater over both the frontal convolutions was opaque and light yellowish, with slight flattening of the convolutions extending on the right side to the anterior central, and on the left side to the fissure of Rolando, and a recent suppurative meningitis was present.

The inner surface of the dura mater over the vertex of the cerebrum and over the anterior and middle fossa of the skull presented an older hæmorrhagic membrane, easily removable but without any free hæmorrhage between the dura and the arachnoid.

Lungs: Free from adhesions, distended, and emphysematous. Pulmonary artery enlarged in caliber, with thin walls.

Heart: Right auricle and ventricle distended with fluid blood. Left ventricle between systole and diastole. Valves normal. Muscle slightly brownish. Aorta shows moderate arterio-sclerosis.

Liver slightly fatty. Kidneys slightly enlarged and congested. Spleen, gastro-intestinal tract, bladder, and adrenals negative.

Diagnosis. Fracture of right frontal sinus and orbital plate, with laceration of base of right frontal lobe adherent to dura mater; subsequent necrosis and, through sudden increase of pressure of air in frontal sinus, a direct communication by rupture into the anterior horn of the right lateral ventricle. Recent suppurative meningitis over both frontal lobes. An older pachymeningitis haemorrhagica interna. Slight fatty infiltration of the liver. Chronic congestion of kidneys, and essential vesicular emphysema.

One might well ask how and when this air got into the lateral ventricles, and why the enormous distention of the ventricles with air did not cause such an increase of intracranial pressure as to instantly result in death.

We know that at the time the first radiograms were taken (and this is worthy of note), the air was not in the ventricles; we know that at the operation and at the autopsy evidence of great increase in the intracranial pressure was lacking. We had reached a reasonable conclusion that it was air within the ventricles and not gas, the product of a gas-forming bacillus, because of the sterility of the fluid from the ventricle tapping and the general absence of symptoms of any virulent infection. At the autopsy, after seeing the fracture of the orbital plate and its connection with the fractured frontal sinuses, we surmised that while blowing his nose he had forced the entrance of air; but we did not know, however, how to account for the absence of more positive evidence of intracranial pressure. This was cleared up by the following information imparted to Dr. Riley by a friend of the patient. Two days before the second admission to the hospital this friend called upon the patient and found him sitting down in a chair, holding his head in his hands and groaning. The patient said to his friend, "I just sneezed and had a terrific pain in my head, and then a flow of a large amount of clear fluid came from my nose — about a cupful."

It has already been noted that the skull was exceedingly thin, so that when the blow was received over the right orbit there was a buckling upwards of the orbital plate, which fractured and injured the base of the brain just beneath the right anterior horn. A process of progressive softening took place around this point, and when he sneezed the air went up through the frontal sinus, that portion of it that surrounds the inner surface of the orbit, and forced its way through the orbital fracture and through the overlying adherent softened lacerated area of the base of the frontal lobe into the anterior horn of the right lateral ventricle. The air passed through the foramen of Munro into the third ventricle, through the corresponding foramen of Munro into the left lateral ventricle (antero-posterior pictures show both lateral ventricles distended with air), and through the third ventricle posteriorly into the iter a tertio ad quartum ventriculum (aqueduct of Silvius), into the fourth ventricle, and at the posterior angle of the roof out through the foramen of Magendie into the cisterna cerebello medullaris (cisterna magna), where at the occipital operation we saw it bubbling up through the cerebrospinal fluid in the cistern.

The air was uppermost to the fluid in the anterior horns when we made the tapping in the right ventricle, for the patient was lying on his back, face upward.

The air was uppermost in the fourth ventricle when we did the suboccipital decompression and opened the cisterna magna, for the patient was lying face down with head hanging over the edge of the table. A valve-like closure of the soft parts surrounding the channel through which the air entered must have prevented its outward escape.

The sudden distention of the ventricles with air when the patient sneezed increased the intracranial pressure to the extent only that it forced out into the nose, through the same opening in the bone through which the air entered, the "cupful" of fluid, probably cerebrospinal fluid.

This interchange of air from without for fluid from within evidently maintained the equilibrium of the intracranial pressure; thus the patient automatically decompressed himself and prevented his sudden death.

JUXTA-EPIPHYSEAL SPRAIN AND SPRAIN FRACTURE OF THE LOWER END OF THE RADIUS[1]

By KELLOGG SPEED, M. D., Chicago

IN dealing with injuries at the wrist several cases have been met where the difficulty of diagnosis lay between juxta-epiphyseal sprain and epiphyseal fracture in children or sprain fracture in adults, which could not be classed as true Colles fracture. Colles fracture is defined as one of the lower end of the radius due to falls on the outstretched hand, the line of fracture one inch or less from the wrist, transverse or oblique, with a complicated displacement, and we get in the habit of calling nearly every fracture involving the radius near the wrist joint by that name.

Searching recent literature, especially the advances in X-ray work, lead to an attempt to study the lower radial epiphyses from the standpoint of their manner of growth and closure, looking toward light on the subject of these lower radial fractures and their mechanism and it is desired to show a series of skiagrams in this area. Rotch, in his book on the "Roentgen Ray in Pediatrics," says no epiphyses have appeared in the lower radius at six months of age. The lower epiphysis is shown by skiagram beginning at two years and is well marked from that time on. It did not seem necessary to go back to such an early age, as we are concerned with fracture, and individual skiagrams from seven years of age up would cover the course of these epiphyses for the present purpose.

Ligaments and tendons are inserted near the epiphysis of long bones and the strain of trauma on the wrist joint must be felt in the epiphyseal area for the most part. Treves says: "Partial or incomplete fractures are valuable as showing real mechanics of fracture production: they tell where they began and the nature of the stresses."

The lower radial epiphysis is anatomically the most important, for there the greatest growth occurs, this epiphysis uniting last in the adult although the nutrient artery is directed toward the elbow. Hence its health should be guarded. If split or separated and not properly returned to its former position it may, through subsequent trauma and strain on account of this unnatural position, become a *locus minoris resistensiæ* and favor the establishment there of bacterial activity in those with latent infections in the general circulation.

Study of this series of selected normal individuals of both sexes demonstrates the growth and closure of the radius. This seems to occur as follows: About 11 years of age, the ulnar border of epiphysis begins to close, this slowly travels across toward the inner side of radius, lower epiphysis becomes thicker and larger; styloid process takes form about 14 years of age, grows steadily and at 19 years we find the epiphysis closed, inner side the last, with styloid process still growing. After 20 or 21 the styloid assumes adult form. After seeing this epiphyseal development it is not hard to believe that the epiphyseal area, the last to become ossified and for that reason weaker in some respects, the area subject to the severe strains incidental to falls on the hand on account of the attachment of the strong ligaments of the wrist, should be the seat of cracks and fractures before other portions of the bone. As the hand is more often abducted and pronated, the main stress in falls occurs on the internal ligaments, the ulnar border of the radius held firmly by the radio-ulnar ligament resists and the styloid process gives first as will be shown, the median edge of the epiphysis closing last leaving a weaker spot here to favor this result. The pronator quadratus muscle acting above tends to pull over the upper part of the bone and approximate it to the ulna giving additional counterpull to the tearing out force of the internal lateral ligament.

In epiphyseal fracture exudation of blood occurs, between fragments not widely separated which exudation, if followed by an infiltration of round cells and later organization, might result in the obliteration of the growing function of the epiphysis and finally give a short bone as compared to its companion bone. Where epiphyseal fracture is undetected and the wrist is treated for a contusion, no splint used, the swelling is made greater, persists longer, and gives some impairment of the growing function. Displacements relatively unimportant and not grossly apparent in a clinical sense, if uncorrected, lead to an overgrowth of an edge of the bone tending to produce wrist deflection of the hand.

Corrected and given rest, such fractures of the epiphysis or lower margin of the styloid process hasten to bony union quicker than ordinary fractures as there is less displacement and if the epiphysis is involved its young bone cells become

[1] Read before the Chicago Surgical Society, Feburary 7, 1913. See discussion p. 256.

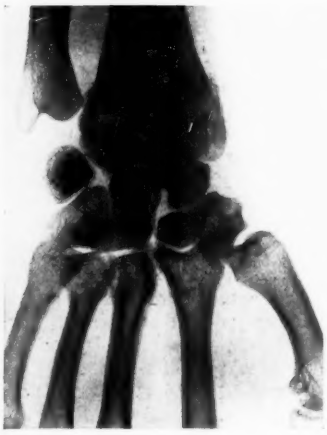


Fig. 1a.

Fig. 2a.

Fig. 3a.

Fig. 1a. Sprain fracture radius with line running longitudinally up shaft. Deformity opposite that of usual Colles, lower fragment pulled down.

Fig. 2a. Skiagram of sprain fracture in woman 52 years old. Illustrates the pulling out force of the lateral ligament on the radial side and the jamming transmission of the continued force through the carpal bones shoving the inner edge of the radial articulation up onto the shaft of the radius as a collar. Ulna unharmed. Much ecchymosis on palmar surface of arm at wrist in midline extending longitudinally, probably due to rupture of interosseous ligament. Point of extreme tenderness of radius where crack is shown. No swelling but much loss of function. No noticeable deformity. Fall on completely extended hand.

Fig. 3a. Sprain fracture running into joint.

acutely active. We hardly appreciate the necessity of placing bony structures as much as possible in normal position. Wiring and plating are not done entirely to correct an overlapping which gives a troublesome shortening or deformity unpleasant to function or appearance, but unconsciously we replace muscles, tendons and joints in a position approaching normal and obtain in return not only a correction of gross faults, but a greater degree of function and movement. As the capsular ligament of the wrist is continuous with the periosteum of the radius, juxta-epiphyseal sprain with tearing of these structures on both the dorsum or lateral surface offers as acute symptoms as epiphyseal or sprain fracture. In the case of sprain the swelling and effusion of serum and blood are deferred, simulating fracture, which is but a further action of an identical force, stopped short of separating the epiphysis or cracking the radius, controlled by the conditions governing its application or the toughness of the capsular structure.

If the capsule tears or gives way the bone does not break as a rule, but as demonstrated by Ross and Stewart, the ligament is stronger than the bone or periosteum and in the majority of tests on the cadaver pulls out the bone surface, or causes by its line of stress a sprain fracture across the impact-receiving area. Stimson believes that too much stress has been laid on the supposed rupture of the internal lateral ligament in sprains at the wrist for his experiments do not show this except in cases with marked displacement. Three causative mechanisms have been worked out:

1. Splitting or crushing, by force from carpal bones.

2. Radius yielding at weakest point by breaking up of the causative force.

3. Cross strain exerted at insertion of capsular ligaments especially on the anterior aspect with hand in dorsal hyperextension.

The last factor has never been given its full value. What in one case will give merely the sprain with ligamentous damage, in another will cause epiphyseal or sprain fracture of the styloid process with little displacement and no comminution. This cross strain, force of which is received by the palm as hand is extended, is exerted just above the end of the bone by the anterior and lateral ligament. As the hand is bent back the ligament is put under extraordinary stress and the lower fragment is broken by being torn off. Stimson admits this can be done on the cadaver but believes there are few clinical cases. In the so-called chauffeur's fracture a like mechanism

Fig. 1b.

Fig. 2b.

Fig. 3b.

Fig. 1b. Excellent illustration of true sprain fracture, lower end of radius. Ulna unharmed, interosseous ligament not torn. Seen 4 days after accident. The opening of the crack can be made out on the articular surface of the radius.

Fig. 2b. Sprain fracture almost exactly across epiphyseal line.

Fig. 3b. Adult man. Sprain fracture both edges of radius at wrist. Outer area shows the cracking and pulling force exerted by the straining ligament. Inner fragment more displaced. Ulna not damaged. Interosseous ligament undoubtedly torn. Complicated by a fissure fracture of scaphoid. Mechanism of fracture in this case due largely to transmitted force from carpal bones, as both edges of radius are cracked off.

caused by the sudden forcible back jerk of the crank handle puts this unexpected and powerful strain on the lower end of the radius when the ligament is tense with the exertion of cranking, resulting in a transverse or diagonal fracture.

Taking first juxta-epiphyseal strain from a fall which gives but slight evidence in the skiagram of the pulling out strain caused by the trauma; following through with more pronounced cases, first of sprain fracture involving a corner of the styloid process, then with more extensive injury cracking the bone nearly across the diameter of the lower end; and finally getting an impaction of the two fragments after this cracking across, with little if any silver fork deformity or antero-posterior displacement, leads on to an ordinary Colles in accordance with the three methods of mechanism mentioned.

Recapitulated, the mechanism seems to follow in this order: fall on hand pronated and probably abducted, tearing stress of lateral and anterior ligament which is tougher than the bone to which it is attached, tearing or splitting off of corners or whole diameter of the radius, continuation of force driving lower fragment up into shaft by transmission of line of force from wrist bones, and finally comminution by a breaking up of the lines of force as trauma ceases.

Fracture force in distinct fracture causes the bone to break frequently in the line of epiphysis and the lower fragment forced on by a continuation of the pressure is driven on up into the cancellous portion of the shaft, giving the impacted Colles. As the swelling and soreness are often not great at first and a superficial examination gives no crepitus, no false motion and little deformity which a sprain alone or a small hæmatoma might account for, these cases do not come to the hands of the surgeon at once, or if they do are not diagnosed. The hand is used to a certain extent and it is only after the acute swelling has subsided and pain persists in the bone and function does not seem to progress as rapidly as the objective findings warrant, that the injured one seeks closer examination or a skiagram and the true condition is revealed. Too frequently weeks have passed in the meantime, bony union has been inaugurated and on account of the proximity to the wrist joint one cannot exert sufficient force even under anæsthesia to reduce the deformity and one hesitates to perform an open operation near the joint when one fragment is so narrow that plating is quite impossible. Such cases are best left alone, resulting ultimately in little loss of function, radial flexion of the hand and thickening of the radius with a humplike

Fig. 4. Epiphyseal separation in 9-year-old boy who fell out of swing. On radial side evidence of tearing out strain of ligamentous insertion.

mass. In very few of these are the external lateral ligaments of the wrist severely injured or the styloid process of the ulna injured, the force causing the fracture evidently having been delivered sharply and along the radial axis in most part, the hand being at the instant in slight abduction.

Juxta-epiphyseal sprain may be as painful and result in as prominent objective findings. Crepitus excepted, one cannot clearly differentiate if the acute swelling has occurred, as the hæmatoma formed by the tearing loose of the ligamentous attachments at the wrist, all in the epiphyseal area, simulates the fracture deformity. Where the epiphyseal area has been split across or the tip of the styloid process cracked with little displacement, measurement of both radii from the condyle of the humerus to the tip of the styloid process may be equal or the injured side slightly longer. Local pain on pressure and loss of function are at first as great in sprain with ligamentous laceration and hæmorrhage as in true sprain fracture.

Skiagrams are of the greatest aid under such circumstances for immediate knowledge, unless one wishes to wait a week for the swelling and pain of the sprain to subside to make a more positive diagnosis by manipulation. In a certain class of cases this is unwise for obvious reasons. Examination with the fluoroscope is not satisfactory where the lesion is so delicate, and closer examination of the dried plate must be had.

Cotton says that separation of the lower radial epiphysis is most common between 12 and 18 years of age, while Walton claims that epiphyseal separation is rare before 10 years and usually occurs about 17 or 18. Separation alone would most naturally happen in the younger children, caused by a fall from a height onto the extended hand and may result in splitting or comminution of the lower fragment, or this fragment may be merely started from its position. This happens, and without crepitus or a carefully studied skiagram the fracture is overlooked at the preliminary examination.

Other fractures seem to vary from this usual method — just why is difficult to state — probably on account of a decided difference in the method of receiving the trauma or a different position of the hand at the time. After an accident causing such injuries it is not always possible to obtain a positive statement regarding the position of the hand but in short falls it is instinctive to thrust the hand nearest the ground out to break the force, catching the weight on the palm or thenar eminence. The density of bones may vary enough to account for a green stick fracture or longitudinal fracture as reported by Parrish, the picture of whose case illustrates well, I believe, the tearing out force of the ligamentous strain.

In some of these cases fracture of the carpal bones has been incidentally noted — whether they are true cases or not seems problematical. I would like to call to your attention in this connection a valuable work recently issued by Professor Thomas Dwight of Harvard Medical School, a clinical atlas of the variations of the bones of the hand and foot. He states, for instance, that in a comparatively small number of adult hands the scaphoid is found completely divided into two or even three pieces, the line of division running obliquely from near the outer end of the articular surface of the radius to about the middle of the concavity for the head of the os magnum and that he feels positive that some cases of reported fracture of the scaphoid, skiagrams of which he has seen, are merely examples of this variation.

In children where there is no great separation of the epiphysis there is found no crushed cancellous bone and one would anticipate an early repair with the epiphysis retaining function but the result is problematical in every instance and cases of premature ossification or loss of growing function of the epiphysis have resulted. Andrews reported such a case in 1902. If this termination follows, the ulna proceeds in its normal rate of growth while the radius remains more

stationary and the deformity consists in a bowing inwards of the forearm, radial side shortened.

Ross and Stewart at the German Hospital in Philadelphia in going over records found that 15 per cent of all fractures confirmed by X-ray were sprain fractures and that in 1910, 11 of these were of the lower end of the radius and that in 1911 there were 7 in the same location. They say, "In order to have a luxation one or more of the strong ligaments must give way, the ligaments do not give way themselves, but the bony tissue to which they are attached gives way, — all luxations are permitted by primary occurrence of a sprain fracture."

As diagnostic signs the following are sufficient:

1. History of sufficient trauma.

2. Small, sharply localized area of swelling and acute tenderness over attachment of ligaments at lower end of radius (and ulna). The findings in sprain fracture under 2 are pronounced and certain, recurring always at the same place when test is repeated so that one can in 80 per cent of cases make a clinical diagnosis before skiagram.

Treatment should be that of fracture. Immobilization of wrist from base fingers to elbow in a light plaster splint, hand in comfortable position generally slightly flexed, and forearm midway between pronation and supination. After 10 to 14 days, splint removed, arm massaged, and after third week no support needed. This avoids prolonged disability from "sprains," excess callus formation and gives better satisfaction to the patient.

REFERENCES

ANDREWS. Ann. Surg., Phila., 1902, xxxv.
COTTON. Dislocations and Joint Fractures.
WHITELOCK. Sprain and Allied Injuries of Joints.
WALTON. Fractures and Separated Epiphysis.
STIMSON. Fractures and Dislocations.
PARRISH. Longitudinal Fracture of the Lower Extremity of the Radius. J. Am. M. Ass. lx, No. 2.
ROTCH. The Rœntgen Ray in Pediatrics.
DWIGHT. Variations of the Bones of the Hand and Foot.
ROSS and STEWART. Ann. Surg., Phila., lv, No. 1.

AN APPARATUS—ANÆSTHETOMETER[1]—FOR MEASURING AND MIXING ANÆSTHETIC AND OTHER VAPORS AND GASES

BY KARL CONNELL, M. D., NEW YORK CITY
Instructor in Surgery, College of Physicians and Surgeons, Columbia University; Assistant Surgeon, Roosevelt Hospital

1. Foreword.
2. General Considerations: The desirability and achievement of accurate dosage.
3. Description of the anæsthetometer.
4. Details of ether anæsthesia. Percentages of ether required by man. The technique of delivery.
5. Use of the anæsthetometer in nitrous-oxide-oxygen anæsthesia.
6. Use in measurement for other therapeutic purposes.
7. Summary.
8. Appendix. A. Technical details of calculations. B. Discussion of the utility of heat; first, in the vaporization of ether; second, in securing humidity in inhaled vapors; third, for therapeutic purposes.

1. FOREWORD

PRIMARILY, the anæsthetometer (Fig. A) here described was designed to measure air, and to volatilize therein any desired per cent by weight of ether; secondarily, to mix in measured proportion two or more gases, such as nitrous-oxide, oxygen, carbon-dioxide, or air.

The object of these procedures was to secure an even, safe, efficient narcosis, believed to be attainable only by complete and continuing knowledge and control of the dosage.

The results achieved in the delivery of the measured dose by this instrument, particularly by intratracheal and intrapharyngeal insufflation, have been to increase the safety and efficiency of surgical narcosis, to decrease the shock of operation and the sequellæ of ether anæsthesia, and to afford precise data on which to base the dosage of an anæsthetic. In fact, the most advantageous anæsthesia can be plotted in advance for the type of individual and operative procedure, and maintained after the preliminary stage entirely automatically.

[1] This word has been coined, in the lack of an existing term, to designate an apparatus or instrument for the automatic measuring and mixing of vapors and gases used in anæsthesia and for other purposes.

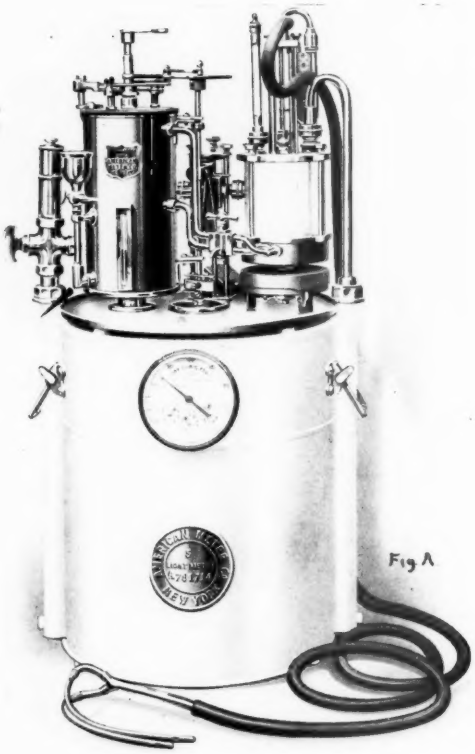


Fig A

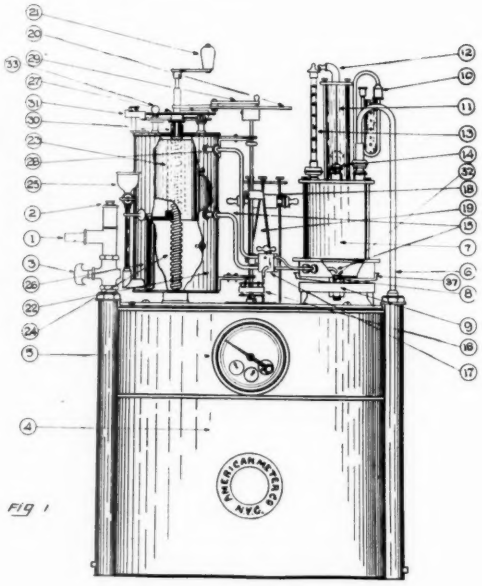


Fig 1

2. GENERAL CONSIDERATION

The necessity of exact dosage for drugs in the solid and liquid form has long been recognized. With volatile and gaseous drugs, dosage has remained inaccurate and largely a matter of individual physiological experimentation because of the lack of an automatic, precise measuring instrument.

The reasons, no doubt, for the present inaccuracy and lack of scientific data in handling this latter type of drugs, more particularly the anæsthetic vapors and gases, has been the technical difficulty of measuring and delivering matter in such an elusive state as the gaseous. In fact, in gauging an anæsthetic given by inhalation, the patient has been used as the only available indicator of the amount and concentration of the drugs administered. It is true that the patient under light anæsthesia is a fairly sensitive gauge, and it must be admitted that even in the stage of full narcosis when the patient ceases to be a sensitive gauge immediately serious results are uncommon. No doubt this is due to the wide tolerance of man toward a toxic overdose of the more common anæsthetics, and to the power of prompt elimination of volatile and gaseous matter held loosely in the blood. Yet obviously the use of the patient as a measuring gauge, and the varying personal capacities of the anæsthetist as the measuring agent, are unscientific and undesirable and should if possible be replaced by accurate, physical measurements. Nor can the surgeon's duty to the anæsthetized subject be fully performed without a complete and continual knowledge of the volume and dilution of the dose administered.

Efforts have been made to achieve mechanical accuracy in anæsthetic mixtures by blowing air over or through a volatile anæsthetic, or by dropping volatile anæsthetics into the air stream. These procedures, while delivering a more constant vapor than the skilled anæsthetist can do, have made no fundamental advance. For in these efforts no accurate information has been secured as to the quantity and concentration of the vapor mixture delivered, and, in fact, the patient has remained the gauge by which the usual procedure must be adjusted.

It seems obvious, without further discourse, that the primary measurement of dosage, by physiological tests, should be superseded, in the case of gaseous drugs, as it has long been with

solid drugs, by the administration of exact amounts, and that the invaluable physiological reaction should be reserved as a control and a court of final appeal.

Dosage defined. In the administration of a gaseous drug by pulmonary absorption, exact dosage involves the maintenance in the gas—that is, air-volume of the upper respiratory tract—of a known content by weight of this drug, which by diffusion throughout the lung and absorption into the blood, will induce and maintain a desired physiological effect. For ideal anæsthesia this desired effect requires the constant maintenance, in a sufficient tidal volume, of the lowest percentage of anæsthetic which will hold a given individual safely and evenly anæsthetized in a degree suitable for the surgical operation in hand. That this is possible by the use of the anæsthetometer will be presently shown. To what extent this ideal is approached by the traditional and usual methods depends on the experience and skill of the anæsthetist. But particularly remote from the ideal is anæsthesia in the average hospital, with its ever-shifting house staff, leading sometimes to the immediate endangerment of the patient or to the discomfiture of the surgeon and even to those avoidable and sinister sequellæ which mar the records of too many hospitals. Yet, however expert the anæsthetist may be, it remains true that exact determination of dose is to be achieved only by a physical measuring instrument, and that ideal dosage is to be realized only by, first, supplying in accurate per cent of dilution the entire volume per moment needed for respiration, and second, by continuously placing this volume, in the patient, where it will be the most effectually utilized.

Beyond question, intratracheal placement of the dose approaches most nearly to the ideal. Next to this, and far more easily achieved, is the insufflation deep in the pharynx. Crudest of all is that delivery by face mask which places the measured dose distal to the pharyngeal structures, now paralyzed, which may block respiration.

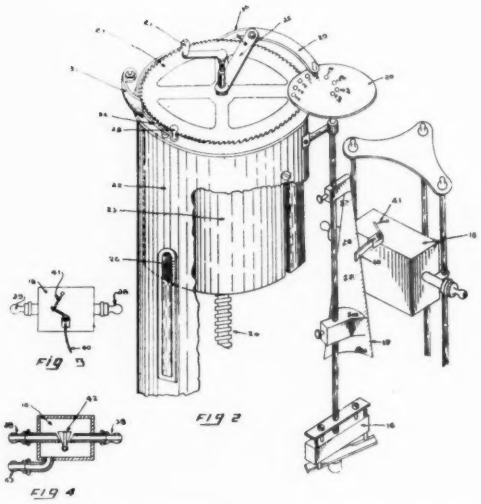
Apart from the immediate practical advantages to the individual which the introduction of an accurate measuring instrument affords, remoter benefits of scientific importance may be confidently antipicated. For presently, exact data from different sources will be available, so that surgical anæsthesia instead of being maintained, as at present, according to personal reaction and the formulæ of the individual anæsthetist, may be on an established basis of exact measurement and dosage. The maintenance of anæsthesia instead of being experimental with each individual could be plotted in advance within narrow limits for the type of individual and the nature and stage of the operation.

By an instrument of accurate measurement already there has been accumulated data on about 400 cases at Roosevelt Hospital as to the exact percentage of ether by weight at sea level needed, in inhaled or insufflated air, to maintain in the various types of humanity the various degrees of surgical anæsthesia. Similar figures in regard to nitrous-oxide oxygen mixture are in process of accumulation. These will be merely touched upon in this paper, and, with some previous data collected by a less accurate instrument, form the basis for a more complete communication.

The statements of accurate measurement herein deal only with the stage of actual anæsthesia. It is obvious that through the stage preliminary to relaxation, ideal dosage by the respiratory tract is not feasible, since through the preliminary stage of anæsthesia only such concentration of the drug can be administered as the patient will inspire, regardless of the scientific requirements. But definite dosage through this stage is a matter of secondary importance, the primary consideration being to abolish the active reflexes and saturate the blood to the stage of surgical anæsthesia, by every art of the skilled anæsthetist, with the minimal nervous and respiratory irritation. However, when the pharyngeal reflex is abolished, and the laryngeal reflex much blunted, then the accurate administration, even of irritating vapors, becomes feasible. It is in this stage that it is particularly encumbent on the operator to administer a sufficient volume for respiration of a dilute vapor mixture bearing the lowest percentage of anæsthetic possible for the type of patient and operative procedure.

Before describing the details of the anæsthetometer it seems wise to state that the apparatus as figured in its entirety in the appended diagram may appear to the non-mechanical mind very complex, yet each of the four units of which it is composed is of simple construction. Each unit fills a necessary function, for the most part automatically, and there is little likelihood of derangement. In fact, the only complex part in the apparatus is the gas meter which has been reduced, through a century of development in the illuminating gas industry, to the automatic marvel found in one's own basement (frequently accused of falsifying, it is true, but rarely convicted of this, or of neglect of duty).

The actual operation of the apparatus is very



simple. Its control by the anæsthetist centers in the movement of a single pin.

The instrument in its present form has been in continuous use at the Roosevelt Hospital for the past six months. It is an evolution from a year of experiment on the various mechanical mechanism. The design for measurement as to quantity was based on the deductions drawn from several years' use of the Elsberg apparatus at the Roosevelt Hospital. More accurate data for the construction was gleaned from a use for six months of the writer's gas gauge vaporizer.[1]

3. DESCRIPTION OF THE ANÆSTHETOMETER

General. The principle of the anæsthetometer as an ether vaporizer is as follows: Air or other gas under pressure in passing through a gas meter actuates the usual recording mechanism. Simultaneously the same mechanism automatically feeds the proper amounts of ether into measured volumes of air, to maintain an exact percentage by weight of ether to air.

This apparatus may be instantly adjusted to deliver any measurement, within the range of percentage by weight of ether vapor in air, found to be useful in maintaining surgical anæsthesia. The output remains constant at that known per cent. The volume of the vapor mixture is then adjusted as desired, to supply the entire tidal air.

The anæsthetometer as designed for ether anæsthesia consists of three assembled units, a gas meter (No. 4, Fig. 1), an ether reservoir (22, Fig. 1), and a vaporizing chamber (7, Fig. 1). For nitrous-oxide oxygen anæsthesia a fourth unit is combined, namely, a gas oxygen trip-valve (18, Figs. 1, 2, 3, 4). For a third gas, such as carbon-dioxide, a second trip-valve is combined.

Detail. The *first unit*, the gas meter (No. 4, Fig. 1), is an accurate, light, powerful meter of the dry meter type. It is a modification of what is known in commerce as a round, five-light, three diaphragm, dry, test meter. It is a high-grade measuring instrument, a development of the past century in the illuminating gas industry. The metal parts are of brass and nickel, and are accordingly indestructible. The leather diaphragms, such as exist in all dry gas meters, will stand some years of service and may be replaced at small cost. The reservoir is tested to two pounds pressure, and is capable of passing 30 litres of air per minute on a differential of 5 mm. Hg. of pressure. It was adopted by the writer as the gas measuring and ether motive mechanism after exhaustive consideration of the various types of wet and dry meters. It has a dial (No. 5, Fig. 1) registering by a large hand, ten litres in fractions to each revolution, and smaller hands adding the total quantity. The same gear which drives the registering hand also drives a mechanism which feeds ether into the vaporizing chamber (Fig. 2) (16, 20, 29, 36, 27, 24, 23). The ratio of this feeding mechanism can easily be shifted by replacing the pin of (29) on disc (20), so that any percentage by weight of liquid ether from 0 to 26 per cent may be added automatically to the air as it passes through the vaporizer. (For details of calculations see appendix A.)

The *second unit* of this instrument is an ether reservoir (22, Fig. 1.), of a litre capacity. This is a nickel cylinder with an outflow pipe at the middle (15, Fig. 1) and an air pressure equalizing pipe at the top (28), each connected to the vaporizing chamber.

The upper half of the reservoir is normally occupied by a piston (23, Figs. 1, 2), the lower half by liquid ether. The piston does not revolve, but is moved down and up by rotation of the central screw upon which it rides. When the piston descends, actuated by the central screw (24, Figs. 1, 2), liquid ether is displaced, and flows through the overflow tube (15, Fig. 1) out of the reservoir into the vaporizer (7, Fig. 1). The rotation of the screw and descent of the piston is accomplished by the engagement of a ratchet (36, 27, Fig. 2) governed in its motion by the revolving disc (20, Fig. 2) moved in turn by the gas meter. Thus one tooth up to sixteen teeth may be moved by the meter with each revolution depending upon the set of the pin on disc (20). The movement of one tooth displaces such a weight of ether that this when added to the air passed by the meter in one revolution results in a mixture of 2.18 per cent by weight of ether vapor in air. (See appendix A). The number of teeth moved with each revolution of the meter depends on the eccentricity of the hole on disc (20, Fig. 2). Such movement as has been found clinically useful is selected and the proper percentage stamped alongside the hole.

The reservoir holds 360 grams. of ether, or enough to last through a long operation. The descent of the piston may be seen through a glass window (26, Figs. 1, 2) in the reservoir. When it reaches the bottom all the ether has been displaced.

To refill the tank the ratchet is thrown off by a lever (33, 34, Fig. 2) so that the teeth are disengaged and the piston is again wound up by a small crank (21, Fig. 2). Next the air and ether pipe to the vaporizer is closed by a double, three-way valve (17, Fig. 1) and the ether reservoir is re-

[1] J. Am. M. Ass., lx, 12, 892.

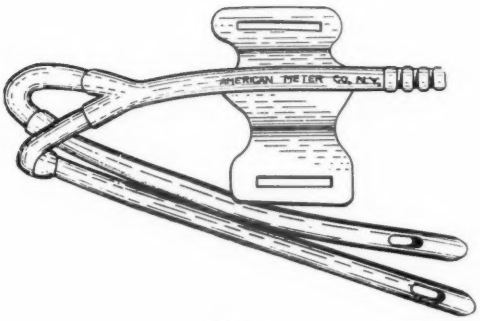


Fig. 5.

filled through funnel (25, Fig. 1). When full to level of pipe (15) the excess spills from spigot on valve (17).

The shaft connecting the ether feed to the meter mechanism has a safety friction clutch (16, Fig. 2) which slips in case the ether reservoir is inadvertently allowed to become empty.

The *third unit* is the vaporizing chamber (7, Fig. 1). This is a glass cylinder mounted on a nickel cup (8, Fig. 1). Into this cup a definitely measured amount of ether is automatically poured through pipe (15, Fig. 1) simultaneously with the air which flows from the meter through pipe (6, Fig. 1). An accurate mixture results.

Heat, which is essential to vaporize with accuracy the higher per cents of ether, is furnished by a three-inch electric stove (9, Fig. 1) placed beneath the nickel cup. The heat of this stove is regulated by a rheostat and distributed by water jacket (37, Fig. 1). The exact degree of heat, as will be seen in appendix note is unimportant. As a routine the water is kept at about body temperature. If electricity be not obtainable, the jacket is filled as needed with hot water to maintain accurate vaporization of the ether. (Heat discussed, Appendix B.)

An absorptive disc of porous clay (32, Fig. 1) in the bottom of the cup holds liquid ether momentarily before its vaporization, equalizing any momentary inequalities in the delivery of liquid ether.

The vaporizer is surmounted by a thermometer (13, Fig. 1) reading to 50° C., and by a U mercury gauge (10, Fig. 1) reading to 60 millimeters.

The vapor passes out through a gas gauge (11, Fig. 1). This is a light aluminum inverted cup, the cap of a hollow sphere (14, Fig. 1) riding as a float free on a central rod in a glass tube. It begins to ride on 8 litres (10 grams by weight) of air per minute and rides at increasing heights up to 30 litres (36 grams) of air per minute. The float, or loose piston, rises and falls with the respiratory movement of the patient. It drops instantly on any blockage of the air supply; as for example, a kink in the supply tube. This floating gauge is very useful in pharyngeal and intratracheal insufflation, as the operator may observe at a glance about how much air or other gas by weight is being delivered at any given instant. The calibration in grams per minute is etched on the glass tube.

The *fourth unit* is added to extend the utility of the anæsthetometer to mixing true gases.

This fourth unit added to the three already described consists of a trip-valve (18, Figs. 1, 2, 3, 4) tripped by the gas meter through any measured portion of its cycle. With this unit the meter may be run on two gases, nitrous-oxide and oxygen for example, and deliver automatically with mechanical precision any measured percentage of

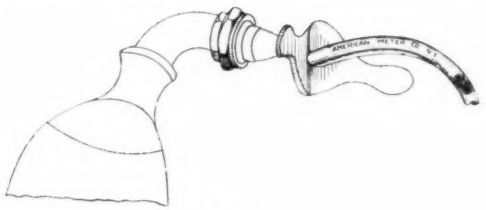


Fig. 6.

gases by volume to which the meter may be set. By the addition of a second trip-valve, complicating necessarily the arrangement of piping, a third gas such as carbon-dioxide may be mixed in exact percentage with two other gases. To these may be added automatically exact amounts of ether. Thus, the meter may be set to, and will deliver automatically, a mixture by volume of, say, 5 per cent of carbon-dioxide, 10 per cent oxygen, and 85 per cent nitrous-oxide; and to this gas volume add if desired, 12 per cent, of ether by weight to 88 per cent of gas.

The working of this trip-valve is as follows: Two inflow ports (38, 39, Fig. 3) are connected, one to nitrous-oxide or other gas under even pressure, the second to another gas, oxygen for example. An outflow port (43, Fig. 4) from the valve is connected by rubber tubing to the meter inflow (1, Fig. 1).

If the inflow port (39, Fig. 4), which is normally open, is connected with nitrous-oxide then the meter begins to run on that gas. At a certain stage of the revolution of the meter a revolving surface or cam (19, Fig. 2) hits the valve spring (40, Fig. 2) and changes the motive gas flowing into the meter from nitrous-oxide to oxygen. The meter then runs on oxygen until the raised surface has passed when the valve snaps back to nitrous-oxide again. This cam is a wedge section of a cylinder against which the valve may be shifted so that the period of engagement may be from 7° 12′, up to 90° of the meter's cycle. The output of the meter can thus be adjusted according to a scale on the cam from 2 per cent up to 25 per cent of oxygen in nitrous-oxide, and remains constantly at that volumetric percentage to which the valve is set. The valve is shifted by means of a set screw and a micrometer adjustment on its carriage. The gases need be supplied under fairly constant pressure, such as is obtained in the operating room supply of modernly equipped hospitals. Under 20 mm. of gas pressure the output of the meter is 12 litres per minute, sufficient for non-rebreathing gas-oxygen anæsthesia. For anæsthesia by intratracheal insufflation the pressure of the supply is raised to 40 millimeters, which will deliver the necessary 18 to 24 litres per minute to the patient through the mechanical resistance of valves, meter and tubing.

Motive power. The most satisfactory source of air supply, and that which should form the equipment of a modern hospital, is compressed air from a central plant, under about one pound pressure, properly washed and controlled.[1] Air supplied to the meter may be compressed by common foot-bellows with slight exertion, but with some annoyance. A more convenient apparatus for routine is a common small rotary electric air compressor, such as many manufacturers supply.

Nitrous-oxide and oxygen must be similiarly supplied for mixture and administration. Used for rebreathing a pressure of 15 millimeters suffices, but for intratracheal and pharyngeal delivery without rebreathing the pressure must be adjustable up to one pound. For those hospitals not equipped to manufacture these gases, a permanent

[1] Described in the International Hospital Record, November, 1912.

installation of a reducing plant such as is installed at the Roosevelt Hospital for utilization of the large high pressure cylinders of commerce, piping nitrous-oxide and oxygen to the ampitheatre, will prove very satisfactory. Small portable apparatus costs as much, is more wasteful in leakage, less effective in reduction, is more encumbering to the operating room, and utilizes gas more expensively compressed in small cylinders than does a permanently installed capacious reduction plant.

4. USE OF THE INSTRUMENT

Details of etherization with the anæsthetometer. For ether vapor in air delivered by face mask methods, the volume is such as to supply the delivery bag with ample fresh vapor. This averages in the adult, without rebreathing, about 8 litres a minute. Beginning at 10 per cent, the strength of the ether vapor in the air delivered is increased gradually in the first two minutes to 26 per cent. By this time the patient is unconscious and in the stage of excitement. The percentages are now rapidly carried to about 38 per cent in the average case. By this dosage, as by the traditional methods of etherization, the depth of anæsthesia is such as to permit within 6 or 8 minutes the undertaking of an operation, although full surgical anæsthesia is not established until about the tenth minute. As soon as relaxation begins the percentage of ether is lowered, reaching 26 per cent the tenth minute and 21 per cent in another few minutes. The percentage is now gradually decreased until by the end of 30 or 40 minutes the 15 per cent line is reached. At this percentage full surgical anæsthesia is maintained for hours. Lower percentages result in light anæsthesia and in the gradual recovery of sensibility. All types of man run about the same curve in degree, varying only in the time and difficulty to arrive at a state of complete anæsthetic saturation; i. e., an anæsthetic tension point of all tissues of the body equivalent to 15 per cent of ether by weight at sea level in the alveolar air, or a tension of 48 millimeters of mercury pressure. This saturation requires about five minutes in the least resistant babe up to 40 minutes in the most resistant robust alcoholic.

Delivery by insufflation is far more convenient and effective than by face mask. For ether vapor delivery by insufflation the following technique has been evolved from about 400 cases of intratracheal and 500 cases of intrapharyngeal insufflation through the past two years on the service of Dr. Charles H. Peck and Dr. Charles N. Dowd, at the Roosevelt Hospital.

For each method of delivery full preliminary anæsthesia is induced by usual face mask methods. When the patient becomes relaxed and the pharyngeal reflex is abolished, the delivery tube is introduced.

For intratracheal delivery by the Meltzer method, the patient is intubated after the technique of Elsberg, and is placed on a delivery of 21 per cent ether vapor in 18 litres of air per minute.[1] In from three to five minutes, when the patient is completely relaxed and has ceased exaggerated and stertorous respiratory efforts and is sleeping quietly, the percentage of ether is lowered to 19 per cent, in about twenty minutes more to 17 per cent, through the second half-hour to 15 or 14 per cent, and through the second hour to 12 or 10 per cent of ether in 18 litres of air per minute.

Alcoholics, muscular fat people, athletic boys from 14 to 26, and girls from 16 to 26, must occasionally be placed on 24 per cent ether for a few minutes and maintained on 21 per cent for 15 to 20 minutes to be held relaxed.

Operations involving pulling on the mesentry and biliary passages, within the first 45 minutes of anæsthesia, require 21 per cent ether vapor for a few minutes prior to and during such manipulation as may be attended by shock. This ensures control of respiration, quiet anæsthesia, and the blocking of shock and muscular rigidity.

These percentages and volumes carry the average case automatically, under light, even, absolutely safe narcosis. The volume may be lessened for small individuals or during stages of light respiratory movement and the percentage lowered two or three per cent for unusually frail or susceptible individuals, and for mere plastic operations involving no nervous shock and where complete relaxation is unnecessary.

While intratracheal delivery of the anæsthetic by the Meltzer method is ideal in so far as control of anæsthesia and aëration goes, and is almost the mandatory method for intrathoracic surgery, yet the existing inconveniences and delay of intubating the trachea will bar it for the present from general adoption as a routine method. On the other hand, pharyngeal delivery of the anæsthetic, as described by the writer, has no such obstacle and being very efficient will undoubtedly become the method of choice as a routine, when the length of operation warrants the establishment of a scientifically maintained ether balance,

[1] The routine volume is 18 litres as measured by the meter. This is not the true bulk delivered, for when ether is added at the vaporizer, the bulk is increased and again increased when the gas volume is released from compression at the delivery orifice and becomes further expanded by the absorption of body heat. The resultant volume from 21 per cent of ether by weight vaporized in 18 litres of air as usually delivered, i.e., pressure 790 mm.humid at 22° C, is 19.85 litres, the density of ether vapor being 2.586. The ultimate volume delivered into the patient, when decompressed to 760 mm. and heated from 22° C. to body heat (disregarding the addition of water vapor), is 21.7 litres per minute.

as for example in operations upward of ten minutes in duration. The following method, elaborated at the Roosevelt Hospital, from the insufflation method of Junker and others, has most of the advantages of intratracheal delivery in quiet, efficient, automatic anæsthesia, and eliminates the inconvenience and possible dangers of intubating.

Pharyngeal reflex being first absolutely abolished by preliminary nitrous-oxide ether anæsthesia, tubes are inserted through the nose, and the lower pharynx is kept flooded with such a quantity of dilute ether vapor as to provide entirely the tidal air inspired.

The delivery is accomplished by two No. 18 F rubber catheters with double eyelet passed one through each nostril to a point behind the epiglottis. In case of nasal obstruction they are both passed through an unobstructed nostril or through the mouth. The tubes are attached to a curved metal Y, the writer's nasal tube (Fig. 5), which fits the nose and forehead.

The average initial delivery, instituted only after the patient has relaxed, is 21 per cent ether vapor in 18 litres of air, making in total a volume of about 20 litres. More often than with intratracheal insufflation this percentage must be raised to 24 per cent, and for upper abdominal surgery in alcoholic subjects, even up to 26 per cent, since these cases as a rule breathe poorly and inspire only small volumes until they become fully relaxed. Usually within five minutes the percentage may be lowered to 19 per cent, and then to 17 per cent, and finally, through the second half hour, to 16 or 14 per cent, and to 12 or 10 per cent through the second hour.

As a guide to shifting the percentage, the reaction of the patient to manipulation at the operating field is the best physiological index. The ordinary signs of pupil, conjunctival reflex, et cetera, are not disregarded. The patient is carried so evenly and lightly that a sudden increase of ether percentage should result in hesitancy of respiration or cough. Percentages below 14 are not useful through the first hour, except for extremely light anæsthesia, or in unusually susceptible individuals. The physiological effect of percentages above 21 per cent must be watched. Between these two lies a safe, it may even be stated non-lethal, fool-proof zone.

A preliminary report of pharyngeal insufflation as practiced by the writer with a less accurate instrument has been published.

Since the preparation of that report six months ago the present meter has been employed. Through the more accurate records made possible by this instrument it has become evident that the dose delivered should in the average be as liberal in quantity and percentage as is set forth in this paper to yield in the hands of the average novice anæsthetist a uniformly satisfactory result.

The quantity of ether consumed in a given time varies greatly with the method of delivery employed. It must be emphasized in this connection that the gross weight of ether consumed is not equivalent to or even an approximate index of the true dosage, i.e., the average percentum of ether which is being maintained in the upper respiratory tract. It is obvious that by employing closed methods and constant rebreathing, the actual intratracheal content of anæsthetic may be high and the patient deeply narcotized with a very small consumption of liquid ether. On the other hand the ether content of the respired air bulk may be very low and as a result the patient insufficiently anæsthetized with an enormous consumption of liquid ether because the vapor is too greatly diluted with air. For example, by careful administration and excessive rebreathing the amount of ether consumed in the first hour after the production of complete surgical relaxation may be kept below 60 grams, accomplishing a degree of anæsthesia that cannot be maintained by ten times that amount of ether vaporized into air insufflated at an excessive rate, say at the rate of fifty litres a minute. No doubt proper middle ground exists.

It is the opinion of the writer that for ether anæsthesia a wholly fresh supply of air should be made available for each inspiration. By face mask a wholly fresh delivery is not feasible, nor can the gas volume demanded by an act of inspiration be so completely satisfied by delivering the vapor mixture distal to the upper pharynx. By closed mask without rebreathing the average adult under full surgical anæsthesia utilizes from 4 to 9 litres a minute, depending upon four factors; first, the usual respiratory capacity of that individual; second, the degree to which the respiratory mechanism reacts to the stimulation of ether and of operative manipulation; third, as regards mobility of the chest, the position of the patient, whether cramped or free; and fourth, the completeness with which the anæsthetist keeps the paralyzed and obstructed upper respiratory tract open.

For the methods of delivery which the writer prefers, i.e., intratracheal insufflation for special cases and intrapharyngeal delivery as a routine, the proper volume of insufflated air and anæsthetic vapor is two and one half to three times

the tidal volume of that individual at any given period. As a basis 18 litres of air per minute may be indicated as a proper amount. To this ether is added, increasing the gas bulk slightly. (See footnote, page 250.)

The major part of this air as well as the ether which may be volatilized therein is wasted in so far as any physiological effect goes, being only of mechanical utility; first, in increasing the force of expiration to blow mucous, blood, and other foreign material from the upper respiratory tract; second, in providing in total for the entire inspiratory volume, without the undesirable occurrence of extraneous dilution.

Using 18 litres of air as a vehicle, six grams of ether per minute are used during the first few minutes of surgical relaxation; later in the first half-hour, five grams; during the second half hour, a little less than four grams; and during the second hour somewhat less than three grams. This amounts in the average case, without special endeavor to economize ether, 160 grams in the first half-hour, 115 grams in the second half-hour, 96 grams in the third half-hour and 60 grams in the fourth half-hour of continuous surgical relaxation. By nicely adjusting the volume and percentage to a given individual and to the steps of an operation, these gross weights of required ether can usually be cut by one third and occasionally by one half, yet not with uniform success in unskilled hands. Occasionally, in subjects resistant to ether intoxication of the types previously noted, an amount as high as 320 grams has been required in the first hour of surgical anæsthesia by intrapharyngeal delivery, and by intratracheal a maximum of 290 grams has been employed. These amounts are exclusive of that used during the preliminary stage.

Ether percentages herein given are relative to air at sea level. At higher altitude, while unlikely that more ether by weight, or air by bulk, will be required, yet the relative percentage of ether would be much increased. (See Appendix A.) To this ascending ratio the meter almost completely adjusts itself, since the ratio of mixture in the vaporizer is by weight of ether into bulk of air.

5. THE USE OF THE ANÆSTHETOMETER IN NITROUS-OXIDE-OXYGEN ANÆSTHESIA

The technical delivery to the patient as regards quantity, percentage, and mode of delivery of this anæsthetic agent will be merely touched upon in this paper and taken up more fully subsequently.

The writer's experience in this form of anæsthesia does not warrant more than these provisional statements.

First, control over the volume and per cent of gases delivered and the intrapharyngeal method of delivery promises to place gas-oxygen anæsthesia on the scientific and automatic basis on which automatic insufflation of ether vapor now rests.

Second, preliminary narcosis by alkaloidal intoxicants may be dispensed with even in abdominal surgery, if one is prepared to supplement the light anæsthesia of nitrous-oxide by from 14 to 26 per cent of ether vapor intelligently introduced for a few minutes prior to each stage of the operation which may induce shock, such as incision through the skin, the peritoneum, the periosteum, and traction on viscera. A much smaller percentage of ether vapor by continuous delivery will hold the average intra-abdominal operative case relaxed, as well as anæsthetized.

Third, a continuous delivery of about 8 litres per minute of mixed gases is the quantity generally useful. A less volume loses oxygen so rapidly and unevenly by body absorption that no satisfactory automatic dosage can be attained, and the administration becomes entirely symptomatic as with the usual crude mixing apparatus.

Fourth, the mixed gas must of necessity be delivered by closed face inhaler until anæsthesia is well established. Thereafter for a thoroughly controllable automatic delivery, this must be made into the pharynx or trachea.

The following intrapharyngeal delivery has proven very satisfactory. As soon as the depth of anæsthesia by face inhaler allows a shift of delivery, this is accomplished deep into the pharynx by double nasal tube, as described for ether air mixture. Additionally, however, the nose and mouth must be plugged. The nose is plugged by slipping over each fork of the metal Y a small section of thick rubber tubing which acts as a cork to each nostril. The mouth is plugged by the writer's rebreathing tube. This is a flattened copper tube (Fig. 6), curved to fit the roof of the mouth. It has an adjustable rubber flange which fits between the lips and teeth, hermetically sealing the mouth, and a common rubber gas bag attached to the distal end.

A delivery of 8 litres a minute is instituted. The bag is inflated by the expired gas to any desired degree of positive pressure, the excess being allowed vent from the distal end by stop cock. Rebreathing is utilized in this form of anæsthesia and not in ether anæsthesia because of the greater cost of anæsthetic, and because of the stronger theoretical grounds for belief in the production of acapnœa in this form of anæsthetic. The anæsthetic thus administered costs, for com-

mercial gas, two cents per minute. Economy to one cent can be made by decreasing the total quantity by half and by considerably increasing the percentage of oxygen.

The same remarkable picture can here be safely duplicated which in intrapharyngeal insufflation of large volume of mechanically delivered air-ether vapor startles the uninitiated observer, i.e., a patient sleeping, automatically anæsthetized with no anæsthetist in proximity to the patient.

For delivery without rebreathing, 12 litres a minute must be supplied for face mask; and for intratracheal and intrapharyngeal insufflation, 18 to 24 litres per minute.

As a routine, the initial bag of gas for the face mask is filled with pure nitrous-oxide, then connected with the meter on a 5 per cent oxygen delivery in a total bulk of 8 litres per minute. Gradually the oxygen per cent is increased to 12 per cent, or even higher if the quantity delivered be small and the gas be rebreathed much.

A rapid change of per cent by the anæsthetometer cannot be made, since the residual volume of the meter wherein the gases are mixed is about 15 litres. So that a direct supply tube of oxygen must be available when needed for emergency use and for the recovery stage. In practice, the supply tube to the meter is tapped as needed. However, the necessity of any except gradual changes in oxygen per cent is almost eliminated by the reliable constant flow of known per cent and volume, provided the operator keeps the respiratory tract open, or delivers the anæsthetic into the pharynx.

Given a reliable supply of gases under sufficient working pressure, by the use of this instrument the following factors in the successful administration of this anæsthetic are put under the absolute control of the operation: first, continual knowledge and control of the quantity and pressure of mixed gases being delivered; second, automatic mixing to the absolute percentage desired of each gas by volume; third, registration of the total volume of gases used; fourth, automatic addition of the percentage of ether desired.

6. THERAPEUTIC USES OTHER THAN FOR THE MAINTENANCE OF ANÆSTHESIA

Aside from use in anæsthesia the anæsthetometer is valuable to measure the air used for artificial respiration by intratracheal insufflation. Also to enrich the measured air volume with a known percentage of pure oxygen.

For artificial respiration in carbon-monoxide, morphine or other asphyzial poisoning and in failure of respiration, about 18 litres of air per minute intratracheally insufflated is a clinically sufficient quantity. If respiratory movement is entirely suspended, the nose and mouth are blocked about four times a minute for a few seconds at a time to expand the chest and more completely aërate the lungs, or else the delivery pressure is increased and the flow interrupted four to eight times a minute for a few seconds, which still keeps the quantitative delivery at a total of 18 litres.

The meter may also prove useful to measure the total carbon-dioxide administered for conditions of shock or to mix this gas in proper proportion with air or oxygen.

7. SUMMARY

The anæsthetometer is an apparatus for the automatic measuring and mixing of vapors and gases used to maintain anæsthesia and for other purposes.

The apparatus consists, first, of a gas meter as the measuring and motive mechanism; combined with, second, an ether reservoir from which volatile liquid is fed in accurately adjustable amounts; into, third, a vaporizing chamber; which is combined, fourth, with a trip-valve by which gases in any quantity may be mixed in accurate percentage.

By the use of this apparatus, that accuracy of dosage in the administration of gaseous drugs so long deemed necessary for liquids and solids is secured.

By the use of the anæsthetometer, particularly in the intratracheal and intrapharyngeal delivery, the dosage of gaseous anæsthetics becomes automatic, yet under the continuous observation and control of the operator. Thus efficiency and safety in prolonged anæsthesia are secured, and the shock and sequellæ of ether anæsthesia are largely eliminated.

Finally, it may be confidently expected that by the accumulation of accurate data such as this instrument makes possible, anæsthesia by pulmonary absorption will be placed on such a scientific basis as accurate determination of dosage alone can secure.

The writer desires to express his obligation to Dr. Horatio B. Williams of the Department of Physiology, College of Physicians and Surgeons, Columbia University, New York, for much of the data for the solution of the problems in physics herein involved; also to Dr. Walter Boothby, who has confirmed, in the Laboratory of Surgical Research at the Harvard Medical School, the accuracy of the vapor percentage delivered; and to Dr. Charles H. Peck and Dr. Charles N. Dowd, on whose services at the Roosevelt Hospital, New York, the instrument and technique have been developed.

APPENDIX A.

Technical calculations. The percentage is calculated for this instrument for average conditions, remaining in the average correct to within one-fifth of one per cent, except for violent fluctations from the average of barometric pressure or of temperature.

The standard instrument is calculated for sea level. A table of corrections is furnished for each 1,000 feet of elevation. The calculation is based on the following physical data, which is given to show the physical basis on which the instrument is constructed, and to render accessible the data for minute corrections, which, while negligible from a practical standpoint, must be stated for scientific accuracy. The standard physical formulæ by which these calculations are made are necessarily omitted from this paper because of their length and complexity.

The meter passes four litres of air per revolution.

Dry air at 0. C. pressure 760 mm. Hg. weighs 1.293187 grams per litre.

However, the conditions under which the air is usually passed by the meter are these: temperature of the air 22° C. under 30 mm. of working pressure, saturated with water vapor at 22° C. The altered weight per litre of air passed under these conditions is as follows:

A litre of dry air under 760 mm. pressure at 22°C. weighs 1.196 grams; under pressure of 790 mm., weighs 1.243 grams; at saturated 22° C. under 790 mm., the vapor tension of water being 19.659 mm. and the density of water vapor as compared to air .6225, the weight of a litre of air is 1.2314 grams. Therefore the four litres of air passed under average conditions at each revolution of the meter weighs 4.9256 grams.

Into this air stream the meter can feed automatically into each four litres or 4.9256 gms. of air, from a minimum of .1104 gms. of ether up to a maximum of 1.964 gms. of ether.

The amount of ether fed is calculated as follows:

The displacement piston (23) has an area of 58.3 square cm. The pitch of the thread on spindle (24) is .254 cm. per revolution. Therefore at each revolution of the ratchet wheel the piston descends 14.8 cubic cm., displacing 10.6 gms. of liquid ether at 22° C. There are 96 teeth on the ratchet. The movement of one tooth on the ratchet wheel by one complete revolution of the air meter therefore displaces on the average .1104 gms. of ether into 4.9256 gms. of air, yielding a 2.19 per cent ether vapor in air. The maximum movement of sixteen teeth yields 26.2 per cent ether vapor. Thus all the range of percentage clinically needed for the maintenance of anæsthesia is available in steps of about 2 per cent.

Finer gradations could be made by use of finer teeth, but 2 per cent is the smallest gradation that manifests any evident clinical effect on man as the subject of ether anæsthesia, according to observation by the writer.

Errors of one tenth to one fifth of a per cent are entailed by atmospheric changes of barometric pressure, temperature and humidity, and by the latitude of error in the instrument itself, but these are absolutely negligible from the practical standpoint. Only by the use of a wet meter and with great training in observation and by calculating every factor of error could percentage correct to a more minute fraction be attained.

The meter automatically adjusts itself to higher relative percentage of ether, probably required at high altitudes by feeding the same amount of liquid ether into the same bulk of air as at lower altitude. The resultant vapor mixture has only a slightly decreased actual weight of ether per litre, although the relative percentum of ether to air by weight is considerably higher than at sea level.

The percentage curve in surgical anæsthesia for various types of individuals and operative procedures, plotted for ether anæsthesia at sea level, will be treated in later communication, together with the theoretical curve for higher altitudes.

APPENDIX B.

Utility of heat. In the vaporization of ether, heat is supplied, not to superheat the resultant vapor, but merely to vaporize the ether completely, without depression of temperature, and without precipitation of moisture. The heat necessary for vaporization of 21 per cent of ether in 18 litres per minute of air under average conditions of delivery at sea level is about 570 gram calories per minute; for 14 per cent ether vapor, about 350 gram calories per minute. The outside air in contact with the vaporizer will not supply this heat. Only from an adequate source of external heat, such as an electric stove or warm water bath, can this heat be supplied without great depression of temperature, uneven vaporization of ether, and almost complete dehydration of the air used. The theoretical depression of temperature caused by vaporizing ether into air at room temperature, i.e., 22° C. in the absence of external heat, would carry a resultant 21 per cent ether mixture from plus 22° C. down to 45.7° below zero. The practical significance of this is that the ether ceases to vaporize evenly and the air loses ninety per cent of the moisture contained.

The addition of heat to a gas mixture for therapeutic purpose is futile, for, as has been repeatedly demonstrated, the specific heat of air is so low (i.e., .237) and also of 14 per cent ether vapor (i.e., .272) or even 21 per cent ether vapor (i.e., .289) that the superheated gas almost immediately becomes room temperature. For example, in passing 23 grams of air per minute (about 18 litres) to a patient, the gas being superheated 20°C., flowing at the rate of 18 feet a second through heavy insulating rubber tubing, within one quarter of one second the gas has lost practically all the superheat and has assumed room temperature. A gas depressed below room temperature will warm with equal rapidity.

Hence any addition of heat is valuable only to effect ether vaporization with accuracy and without dehydration of the mixture.

In regard to the attempt to deliver anæsthetic mixtures above room or body temperature, it may be stated that such a procedure is feasible only by having a warming coil at the patient's face and is of little practical utility. For the heat absorbed from the body to bring a maximum intratracheal delivery of, say 28 grams (20.8 litres) of 21 per cent ether vapor mixture from a room temperature of 22° C. to about body temperature at 36° C. is so slight as to be negligible; i.e., 112 gram calories per minute of heat is abstracted. Vastly more important is it that the air be humid, at room temperature, for heat absorbed from the patient to bring 21 litres of dry ether vapor mixture to within 80 per cent of water saturation at body temperature, is about 440 gram calories per minute, or four times as great as that absorbed in warming the anæsthetic mixture.

However, attempts to deliver air or ether vapor, saturated with water at temperature above the room, is a procedure fraught with danger, in that on the slighest reduction of temperature, precipitation occurs in the delivery tubing, and liquid water is insufflated into the patient.

A calculation of the maximum heat loss by the body under conditions of maximum delivery is as follows: Granted that 28 grams of 21 per cent ether-air mixture saturated at 22° C. under 790 millimeters of pressure is delivered and heated in the body on the average to 36° C. and moistened in the average to 80 per cent of saturation

at 36° C. under 760 millimeters of pressure and expanded isothermally at that pressure, then the total heat absorbed by the gas in the maximum delivery is 422 calories per minute (about one tenth of the total heat loss of the body). The major part of this, i.e., 264 calories, is in water vaporization.

The normal loss by the lung being 155 calories per minute in evaporation and 30 calories in heating inspired air, it will be seen that the heat lost by copious insufflation is about double that of normal. In theory this may sound large, yet when analyzed both in theory and from a practical standpoint, it amounts to about as much as leaving the patient's face exposed.

In view of the cumbersome apparatus that must be assembled to deliver a vapor saturated with water at 36° C. and of the danger of insufflating liquid water, the results justified only the saturation of air at room temperature. The conservation in superheating the gas itself is so small as to be ridiculous.

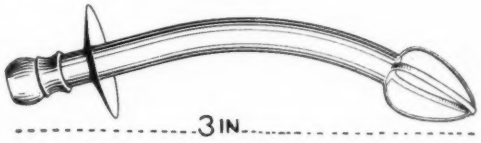
Conclusions. Important as superheat and moisture may be shown for small hairy animals, wherein the important source of heat loss is by pulmonary refrigeration, yet for man the practical results warrant no elaborate efforts to superheat, and to saturate with moisture at superheat, ether-air and other gas mixtures. Nor can the observation of alleged clinical advantage in delivering superheated vapor and gas mixtures find other than ridiculously small foundation in units of physical heat loss.

Heat is valuable, only to effect even vaporization of ether and water under conditions of room temperature.

A MODIFICATION OF SKENE'S RETENTION CATHETER

By JOSEPH RILUS EASTMAN, M. D., Indianapolis

IN the accompanying cut is shown a modification of Skene's well-known catheter for continuous drainage of the female urinary bladder. The openings in the perforated olive-bulb at the intravesical end of Skene's catheter are so small as to become readily plugged, shutting off the flow of urine through the lumen of the instrument, and allowing it to escape through the urethra around the catheter tube. The retention catheter shown here is quite like the ordinary Skene's catheter except that the perforated olive-bulb tip is displaced by four ribs which bow out in acorn form. These ribs should be formed by splitting the end of the silver canula, thus making the ribs from the wall of the tube itself. If the ribs are of wire and



soldered or brazed on, the lumen of the catheter is likely to be encroached upon. The catheter thus made is quite easily introduced and may be withdrawn with gentle traction. Its only advantage over Skene's original instrument is that it offers greater protection against plugging. It should be constructed of silver. No doubt others have made similar modifications of Skene's retention catheter. It seems such a natural step to do so.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 7, 1913, WITH THE PRESIDENT, DR. CHARLES DAVISON, IN THE CHAIR

DR. KELLOGG SPEED read a paper entitled "Juxta-Epiphyseal Sprain and Sprain Fracture of the Lower End of the Radius." (See page 241.)

DISCUSSION

DR. E. WYLLYS ANDREWS was asked to open the discussion. He said: The paper has interested me because I have had the opportunity of seeing most or all these cases during the time of treatment. Dr. Speed has been kind enough in his work at the Mercy Hospital to allow us to utilize a number of these cases in our clinic, where he has patients from the New York Central Lines in our wards. We get a good many fractures of the wrist. I do not see how one can help but be impressed with this paper and the methods described. An hour of this sort with the actual skiagrams from actual cases is worth more than a whole treatise, such as one of those formidable books of Hamilton's, before the day of skiagrams. Now we get pictures of the actual bones and can trace the line of fracture in any given case. We do not have to generalize and theorize about the mechanics of the causation, nor whether the fracture is direct or indirect. We do not have to theorize about the mechanics of reduction and retention, nor whether the fracture is epiphyseal or not, or impacted or not. If we work at it very much as we work on a skeleton, it is an actual mechanical proposition with the means of control at our command. We all realize that it puts the treatment of fractures on an entirely new plane. This report is a series of some value. Dr. Speed has taken the trouble to give us this graduated series year after year by ages showing exactly when the line of ossification is completed. It surprises me to find if this is a criterion, that such a large proportion of these so-called sprains are actual fractures. We have known of cases of fractures of the shoulder joint associated with rupture of the small fragments of the rim of the joint, and in the hip joint we find them in dislocations and fractures of the neck and acetabulum, tearing and stripping off segments of the bone by the ligaments. It is notably so in the wrist joint, and it is absolutely so in the ankle joint. There we seldom get such a thing as a dislocation of the tibia on the tarsus without associated bone injury. We have known for a good while, when we completed our examination by having to operate, the so-called sprains and dislocations are often associated with minute fractures. We did not know as well, before Dr. Speed showed this series of skiagrams, we could locate the tear of the bones. In the wrist cases it is difficult absolutely to differentiate between fracture and sprain or dislocation, so we will have to adopt a different terminology classification. We may use the term here. Dr. Speed has employed "sprain-fracture" or "fracture-sprain." He has shown very definitely that very nearly every sprain will show a little bone tearing.

DR. D. B. PHEMISTER: The lesion, shown in the plate of the 15-year-old girl, in which there is a bulging outward of the radial cortex about one inch above the wrist joint on the ulnar side, is not one of sprain-fracture produced by a pull upon the cortex by the radio-carpal ligaments, as they are inserted considerably below this point. This is a case of folding fracture or Stauchungs Bruch, as the Germans call it. It occurs between the ages of eight and seventeen while the cortex at this level is still flexible. When a not too severe force is received in the direction of the long axis of the radius, the cortex bulges outward in the same way as that of an iron rod where a portion has been heated. Where there is flexion combined the folding will be more marked on the side of the flexion, or present on this side only, as in Dr. Speed's case.

DR. SPEED (closing the discussion): With reference to the remarks of Dr. Phemister, who stated that the pictures seemed to show periosteal callus along the inner margin of the radius, I will say that I have not found it in fresh cases, but it shows in the old cases which we get weeks or

months after the injury. For that reason, I firmly believe they are callus and not impaction, because all of these cases I have carefully measured and none has ever shown any shortening by the usual method of measurement. I want to say in connection with this sort of injury in the shoulder joint that it is rather common to find sprain fracture in the tuberosity of the humerus, where we get partial dislocations of the humerus from falls or injury to the shoulder joint, and this is explained by the partial separation or pulling out of the tuberosity of the humerus by the infraspinatus muscle. This leads to what is frequently diagnosed as a subacromial bursitis, and most of the cases are not that at all. They are more or less sprain fractures, with the pain and tenderness due to the tearing out of the periosteal surface by the infraspinatus tendon. I have been taking pictures of all sprained shoulders I could find, or rather dislocated shoulders, no matter at what age, and frequently find a faint shadow just above and to the outside of the tuberosity where the injury has occurred, and the surface of the bone has been pulled out and shows a shadow at that place even after several months or years.

DR. DANIEL N. EISENDRATH read a paper entitled "Diagnosis and Treatment of Bilateral Urinary Calculi." (See page 218.)

DISCUSSION

DR. L. L. MCARTHUR: Dr. Eisendrath requested me to make some remarks on this subject, because we have had in common a number of cases in our service at the Michael Reese Hospital of this type, and one in particular, the picture of which he has presented.

There are two or three points that I think are well worth discussion. The opinion of the various men who have had experience in this line of work, I should like very much to hear. One is the question of calculous anuria; the other the question of whether reflex anuria may occur. I will first relate an experience which has occurred during the past month that leads me to an absolute conviction that a reflex anuria may occur.

A young boy, age 19, with multiple foci of tuberculosis along the genito-urinary tract, who has been under my care and that of Dr. Favill and Dr. Gregory for five years, and who, after having two of these foci that were suppurating removed (these being in the epididymi of both sides), still had a tubercular bladder, tuberculosis of the prostate, tuberculosis of the subprostatic glands, tuberculosis of the vasa deferentia, and tuberculosis of the testicles. The suppurating foci having been removed, he was then given tuberculin, at that time weighing only 115 pounds. In the course of nine or ten months, after cleaning up the suppurating foci and giving him tuberculin, he came up to 150 pounds. During the past summer he was apparently in perfect health, although still showing purulent urine, tubercle bacilli in the urine, but enabled to play 36 holes at golf, to eat three square meals a day, to play tennis, symptomatically well. Six weeks ago he experienced a sudden left renal colic, intense in character, which because of its severity and the scantiness of the urine which appeared, sent him to the hospital for X-ray pictures of the entire urinary tracts of both sides, but no stones were shown. Stones not appearing, he was treated expectantly for two or three days. He then had relief from his pain. But his elevation of temperature continued; a left tender kidney was enlarged, and the urine was reduced about one half in quantity from what it had been. His hectic lasted for three weeks, the temperature being 101° in the morning, and 103½° in the afternoon. I took him back to the hospital for the purpose of removing a tubercular kidney which I refused to remove five years before because of so many tubercular foci. The left kidney was removed, and its ureter found extremely enlarged—sufficiently to introduce the finger. The kidney was a markedly distended hydropyonephrosis tuberculosa. I therefore felt quite sure that the opposite kidney could do the work, because I thought the ureter, after all the handling I had made, was obliterated, and that the other kidney had been doing the work for three weeks. After the removal of the kidney the patient passed, for the first 24 hours, once 12 ounces; the next time 10 ounces, the next time 4 ounces of urine. I felt surely safe. After that he passed no urine for five days in spite of all efforts to make him do so. He then, after being put in a hot Russian bath apparatus, passed half an ounce. Three days later he passed after a hot bath in a tub, wound and all being in the hot water, an ounce and a half of urine. He then passed no water until the 12th day, when he passed urine and blood, half an ounce at a time four or five times in one morning. After that he never passed urine, and on the fourteenth day became uremic to the extent that he had hiccough and he was somewhat confused. He never became cyanosed. He never became febrile. His pulse stood between 80 and 90 and temperature 98.6°. He died without having pain on the opposite side, after having passed a full quantity of urine during the first 24 hours, and without colic on the opposite side; so that I felt justified in figuring it was a reflex anuria, and not

a calculous anuria, the X-ray picture not showing at any time any calculus on that side, although it had been taken a number of times in five years by Dr. Case. Here, I believe, is an instance in which we have an absolute reflex anuria, and it may occur with a calculous condition on one side and it may not always be possible to determine it. A calculous anuria may occur also without colic, as has been evidenced by the case I once presented before the Society of a cystinuria, and in that case the X-ray picture failed to show a shadow, and will always fail to show a shadow, because cystin is a fatty body which fails to cast a shadow. I opened through the pelvis of that kidney because the calculus I had removed from the opposite kidney had shown it was cystin, and believing that a shower of cystin crystals had come down in the other kidney, I opened the other pelvis and saved that patient, the ureter later being washed out and crystals of cystin having plugged the ureter. We cannot, then, always depend upon our X-ray to help us out on the anuria which may occur.

A second point worthy of comment and caution is the question of prediction of a recurrence. The prediction of recurrence can be made in those cases of calculus removed from the kidney that are of an extremely soft phosphatic type, and even with the most delicate handling have fragments break off from them.

There succumbed to my surgical intervention at Michael Reese Hospital two months ago a man from whom I removed a calculus a year before of such a type. It was so soft and friable that I was sure I had not gotten all of it. It crumbled in such fine crumbles that I put a large tube in the kidney to keep it open for a long time. I had put on the record the probability of this man's having a recurrence of that stone because of these fine fragments which might remain in some one of the calices of the kidney and cause a recurrence. True enough, in a year he came back with the recommendation that that kidney should be removed if recurrence took place. I removed the kidney, but he being septic at the time of its removal failed to improve, and finally died with a chronic sepsis a month and a half after the operation.

I believe, too, that the contour of the calices of the kidney in the cases of multiple calculus enables us to make a prediction of probable recurrence.

There is considerable difficulty in deciding which kidney to select to operate upon, but with Watson, whom Dr. Eisendrath has quoted, I think the one which is causing the most pronounced symptoms is the one which should be selected for removal. It is not always possible to catheterize the ureters, even when you call in an expert to assist you in that, or to do it for you. You are not able to collect the urine from the ureters; you are absolutely at sea as to which kidney is the one that functionally is the more capable — that, I think, in spite of our indigocarmine and other dyes or the sugar test. The only scientifically accurate test of the functional capacity of the kidney in my opinion is that which has been devised by laboratory experiments, namely, that for practically all mammalia a given amount of kidney substance secretes in a given time so much urea to the kilogram of body weight, and that the urea taken as an index in a patient who has an ordinary normal diet will be the best guide—that is, the functional capacity which Harris presented to the society in connection with his segregator—and it has been shown that as long as an individual has enough kidney substance to secrete eighteen kilograms per minute per kilogram of body weight, there is enough kidney substance to maintain life. That is a minimum. It is often much larger. That, too, is a scientific basis on which to make it; whereas the excretion of the dyes or the crystallization of a urine that may be simply concentrated from small amounts of water or diluted from a large amount of water by fluoroscopy is not nearly as accurate a basis.

The case that Dr. Eisendrath has referred to and presented pictures of that has been under my care is that of a young girl who had a left renal colic first, and who, having the stones demonstrated with the X-ray, had them removed, although the right kidney showed stones that were causing no trouble. She remained well for nine months or a year, and then had right renal colic so severe that the stone from that kidney was removed. After a year's lapse of time, the urine never clearing up completely, she came back with left renal colic, both kidneys showing stones in them, for which a third operation of emptying the kidney was done. I heard from her to-day indirectly through her family physician, Dr. Sachs, that she was quite comfortable; that she had some uneasiness in the right side. He desired to know whether it would be injudicious for her to take laughing gas to have a tooth pulled that was ulcerated, because of her renal condition.

DR. A. J. OCHSNER: There is no doubt in my mind but what there is a sympathetic anuria, because I have had personal observation of that condition in several cases in which there was positive evidence.

The suggestion made by Dr. Eisendrath with regard to the wisdom of having both sides skiagraphed is a good one. There is no doubt that many of these cases have renal calculi produced on both sides, and in my own experience there have been many cases in which the calculi have passed spontaneously from both kidneys, and I have operated on several cases upon both kidneys for the removal of calculi.

I have spoken many times regarding the last conclusion which Dr. Eisendrath made which refers to the recurrence of calculi, but I do not know whether I have spoken of it in this society.

Some twenty years ago Harrison of London demonstrated the fact that calculi formed only in case the urine had a certain density, and this density cannot be reached if a patient regularly takes a sufficient amount of distilled water. In that way, it is possible in these cases to prevent recurrence of calculi, provided the patient is sufficiently impressed with the importance of this fact so that he understands it clearly. I have had the opportunity of demonstrating that in a large number of cases. One case which illustrates this was a colleague of mine who could be free from calculi, provided he drank distilled water, but if he got careless and failed to drink undistilled water, the calculi would return. The last attack he had was in 1890. Twenty-three years ago I kept him asleep a whole day with chloroform, off and on, letting him wake up occasionally, and when the attack became severe I would let him go to sleep again. Since that time he has drunk distilled water and has had no attacks, although before that he had recurrences for twenty years.

Another case I had that demonstrated the value of distilled water was one that had renal colic every three or four months for several years until about eight years ago when I put him on distilled water.

For six or seven years he never had an attack until two years ago. During the summer he was building a house, and thought it was too much trouble to drink distilled water, and before the summer was over he had another attack. This patient lived in northern Wisconsin. He came to see me during the attack and by giving him two ounces of glycerine in a pint of distilled water several times, at intervals of twenty-four hours, and half a pint of distilled water every half-hour, he passed a calculus. Since that time he has had no other attack, although formerly by drinking ordinary water he would have an attack every three or four months. At the same time it is important to prevent the urine from being alkaline in reaction.

I have had a number of these cases. The fact remains that if a patient with renal calculi will drink enough distilled water to keep the specific gravity of the urine below 1015 he will not have a recurrence.

DR. EISENDRATH (closing the discussion): Dr. McArthur brought up the point of recurrence of calculi which I did not mention in my paper. These cases of phosphatic calculi are apt to be the ones which recur.

I have been much interested in this whole subject of calculous formation because there are certain analogies which it bears to calculous formation in the gall-bladder. In the urinary tract we have one factor which plays a larger rôle than it does in the gall-bladder. In the gall-bladder calculous formation is favored by the precipitation of salts by stagnation. That is not necessary in the urinary tract. There seems to be two factors in the urinary tract and elsewhere. I do not doubt the experience of Dr. Ochsner, but it does not seem to cover every point. We have discussed the question of the use of distilled water before in these cases. In the first place, there is the question of infection. In the second place, there are disturbances of metabolism which we do not know about. It is possible, of course, by giving large quantities of distilled water, to so dilute the blood as not to favor the precipitation of these urinary salts, but I hardly see how it can play any rôle in such cases as the one I reported of bilateral calculi and also such a case as Dr. McArthur has reported. There it is impossible to get rid of the colon bacillus infection which involves the whole urinary tract. Both kidneys are infected, and unless we can get rid of the infection, there is going to be a relation between the precipitation and salts.

The key to the recurrence of calculi depends (1) upon whether we can control the disturbances of metabolism, and (2) whether we can control infection. Unless we can do both of these things we must expect recurrence in unilateral and bilateral cases. We must prepare these patients. When I operate on a patient for calculus I tell him that I am going to take out the calculus, but I cannot guarantee but what the same conditions will recur; that I cannot guarantee but what in some instances a calculus or calculi will re-form. It is well to-day in doing kidney surgery, more and more to leave a loophole for the future.

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 21, 1913, WITH THE PRESIDENT, DR. RUDOLPH W. HOLMES, IN THE CHAIR

DR. CHAS. B. REED reported "Six Cases of Pubiotomy." Mrs. Z. first came into my service in 1907. She reported that her first labor had lasted six days and was then termi nated by forceps. The child was large and dead.

Her second pregnancy was now near its end. Her pelvis measured: Sp. 20 cm., Cr. 24 cm., Ext. Conj. 17.5 cm., Troch. 29 cm., Conj. Diag. 10 cm., C. V. (est.) 8.85 cm. She went into labor on June 7th and entered Wesley Hospital. After 12 hours of ineffective pains she was prepared for Cæsarean Section. Save that the placenta was attached to the anterior uterine wall, the operation was uneventful and the patient was delivered of a 7-pound boy. Head measured: Bitemp. 7 cm., Bipar. 8 cm. It is probable that this child might have been delivered by version. The Conj. Vera measured directly during the operation was found to be 8 cm. The pelvic bones were unusually large and thick. The convalescence was marked by considerable tympanites.

In 1910 she reappeared with a third pregnancy and refused section. Labor was therefore induced by the metreurysiter at the 36th week. Pains began at once and the 9 cm. bag was expelled in 3½ hours. The cord followed it out so the cervix was slightly incised and version done.

Extraction by Smellie-Veit followed. Woman in Walcher position and the head forced down into the pelvis from above by an assistant. After considerable difficulty the maneuver succeeded. Babe was a girl, which revived slowly and lived. Weight, 5½ lbs. Head measured: Bitemp. 6.5 cm., Bipar. 8 cm., Subocc.-Br. 9 cm.

In August, 1912, patient reappeared with a fourth pregnancy. She steadily refused section and in view of the last experience a pubiotomy was decided upon. Labor began Jan. 25, 1913, and after 14 hours the patient was removed to the clinic. To be sure of complete dilatation the hand was carried into the os and the fist clinched. It was enough. The pubiotomy needle was introduced on the left side brought out well to the left of the labia majora. The bones were severed and fell apart so that two fingers could rest between the ends. The usually free hæmorrhage was readily controlled by compression.

An easy version and extraction followed. The babe was a male, lived, and weighed 6¾ lbs. Head measured: Bitemp. 8 cm., Bipar. 10 cm., Subocc.-Br. 10 cm., Occ.-front. 11 cm. The patient walked on the 17th day and left the hospital on the 21st with a slight limp.

This is my sixth case.

One of the others had an equally interesting history. The first and fifth pregnancies were terminated by craniotomy of the living child, the second, third, and seventh by abortion. The fourth by induction of premature labor at the thirty-seventh week. This child died during delivery.

In the sixth a prophylactic version was done at term and the child died during extraction. She came into my service with her eighth pregnancy in June, 1910.

She was 36 years of age. The pelvis was flat and measured: Sp. 21 cm., Cr. 25 cm., Ext. Conj. 18, Diag. Conj. 9.9 cm. Pubiotomy was done after she had been in labor 12 hours.

The child was a male, weighed 8 pounds, and the head measured: Bitemp. 9 cm., Bipar. 10 cm., Subocc.-Br. 10 cm.

In this small series of six cases one was a primipara and five multiparæ. In all cases the operation was simple in performance, unaccompanied by complications, and satisfactory in result. In no case was hæmorrhage excessive or difficult to stop.

The convalescence in one instance was four weeks; in the others three. In one case the labor had lasted two days and the operation was done to avoid craniotomy on a living but seriously exhausted child which died during the extraction. This was the only death either of mother or child.

In all cases the Cr. varied from 8 cm. to 9.5 cm. In four cases the bones healed with the ends some distance apart and in one of these cases the patient gave birth to the next child spontaneously.

My experience with the operation so far has been distinctly favorable.

PHLEGMASIA ALBA DOLENS

DR. HERBERT M. STOWE: I wish to report briefly an interesting case of acute phlegmasia alba dolens. The patient was a young woman of strong build, twenty-eight years of age, who was delivered normally at her home by a physician. There were two internal examinations made

without gloves and a slight tear of the perineum was found. There was no post-partum hæmorrhage. Fifty hours after labor she complained of a high fever, rapid pulse, and severe pains in the right leg. She came to the hospital and upon her admission she had a temperature of 105°, pulse 140, a leucocyte count of 30,000 and complained of severe headache. Examination of the abdomen showed absolutely nothing. She had not vomited. She had no chills. The abdomen was lax, and was without pain, though the uterus was tender on pressure. The broad ligaments were absolutely negative. The right leg was swollen and quite œdematous, reddened, glistening, and several superficial veins could be made out which were tender on pressure, hard, and felt like a cord. Deep pressure over the femoral vein in the inguinal region also elicited severe pain. A smear of the lochia showed a large number of hæmolytic streptococci. Her pulse went up from 140 to so high that we could not count it; the fever rose from 105° to 109° at the time of death, which occurred forty hours later.

Dr. E. Wyllys Andrews in my absence kindly incised the leg in several places and found a number of superficial and deep veins which were clotted and distended, and bacteriological examination of these clots also showed hæmolytic streptococci. After death a partial autopsy was allowed, and uterus was found to be absolutely negative, and the broad ligaments free, and there was no peritonitis. Nothing was found in the abdomen or the body excepting this condition of the right leg. All the veins of the right leg were filled with this blood clot which extended up to Poupart's ligament, and several of these veins which were examined were full of streptococci.

As phlegmasia alba dolens is a slow infection coming on two or three weeks after labor, we do not expect to find such a condition as was found here. As a general rule, the infection spreads by contiguity of tissue, with involvement of the uterine wall and broad ligaments and pelvic fascia and thigh. In other words, it extends like carcinoma, but this case shows that it can also extend in a manner similiar to sarcoma. That it can extend into other distant portions of the body and not by contiguity is of great interest.

This is a very brief history of the case. There are very few cases of this kind reported in the literature. In an autopsy made at Vienna some three or four years ago on a case of the same character it was found that the entire veins of the left leg had been thrombosed and filled with these streptococci. Evidently the infection is very virulent in these cases, but in the majority of them the infection is of a mild character, and the patient generally recovers.

DR. BACON: What was the object in opening the leg?

DR. STOWE: The idea was that there was pus, but no pus was found.

DR. RUDOLPH W. HOLMES: If I may take the liberty, I would like to report a case which is rather rare, and yet it is not so unique as Dr. Stowe's case.

About five years ago I had a young woman, a primipara, who went into labor. She got into the expulsive stage when the head was beginning to distend the perineum. Suddenly there was a gush of blood from the rectum. Within a few moments the baby was born without difficulty but the perineal skin was absolutely intact. Looking from without, as unfortunately too ordinarily is done, one would say she had absolutely no tear of the perineum, but on opening and inspecting and palpating we discovered there was nothing left but perineal skin. In other words, there was a complete laceration of the skin of the perineum with perforation of the rectum.

Last evening I had another woman, who was exceedingly muscular, about 6 feet and one inch tall, weighing 180 to 190 pounds, starting in at the morning at 3 o'clock with labor pains. The pains did not become active until late in the afternoon of that day. The membranes were ruptured at 7:30 and things were going along beautifully. She was suffering so slightly that it was not thought necessary to give her an anæsthetic. The head of the child became visible and the perineum began to be distended, and I noticed a little hair coming from the rectum. With the next pain that area of scalp and hair was more evident until it was about the size of half a dollar, it having been distended to that extent. Realizing that she would have to have an operation, and that we could save time by operating promptly, she was anæsthetized, and I cut through from the posterior commissure to the rectum with scissors, and the baby, weighing 9 pounds and 10 ounces, fell out. That variety of tear is really very unique.

One thing with regard to the treatment: It is absolutely indispensable — in fact, it is impossible to make an attempt to repair such a condition unless there is complete severance of the skin, making it an ordinary complete third degree laceration. If there is an attempt to approximate the perineal body, the skin is going to well out and you will have pockets in which blood will accumulate and infection will follow, and the integrity of the perineal body will be impaired. With that variety of tear, we are impressed with the necessity of converting it into a third degree tear and proceeding along the ordinary lines.

DR. CHARLES E. PADDOCK: In connection with your case, Dr. Holmes, I will report one and I would like to ask a question. You say we must make a third degree tear. I would like to ask a question, if I am permitted to do so. How far back would you go in making this third degree tear?

Within the past two months a case has occurred in my own practice in an old primipara, thirty-five years of age, with very hard contractions coming on at intervals of at least a minute, every two or three hours, and the question arose of an impending rupture of the uterus. It seems to me, with the hard pains there might be such a thing as an impending rupture of the uterus. In my case an anæsthetic was used to a certain extent, but it seemed to have very little effect unless we put the woman completely under its influence. As soon as the first stage of labor was over the pains continued as bearing down pains, and after a while the case terminated without any tear of the perineum.

Upon examination later, back of the cervix, I found a hole in the rectum. Do I understand that we must, in order to repair this tear, according to your statement, make the incision back far enough to repair the tear which has extended back to the cervix and into the rectum? In this case I did not do that, but I made an opening, repaired it through the vagina, and the result was excellent. These openings must depend upon how far back they are from the perineal body.

DR. RUDOLPH W. HOLMES: In these two cases there was a complete tear of the perineal body with perforation into the rectum without rupture to the skin. Your case, Dr. Paddock, was something entirely different. It undoubtedly was a tear, or rather cut, through the recto-vaginal wall. This was a complete laceration of the perineum perforating into the rectum at the anal fold, leaving the skin intact. In that case it is different from a tear high up in the vagina. A vaginal tear does not need any interference with the perineum, but such a complete tear as this, or where you have a very deep tear, as sometimes will happen, will involve the perineal body. In both of my cases, looking at the perineum, you would say there was no laceration whatever, and yet there was that destruction of the perineal body.

DR. N. S. HEANEY: Your instructions are, in such extreme cases as this, when everything is torn except the skin and the skin remains, to cut it?

DR. HOLMES: Yes, cut the skin open.

DR. HEANEY: If the sphincter is intact, unless you have a tear from the vagina into the rectum, you do not cut it?

DR. HOLMES: If it goes down half way you will have a pocket. This circle (indicating on blackboard) is the skin that if brought together in our case, it is not cut. Here is the line of repair of the perineum. It is hard to bring this skin so that you have absolutely a T-shape. There is going to be a pocket here because in going across you include skin as you go on the other side; and the difficulty of that is, when the blood is always present and welling up, you cannot see. I have had two failures from not cutting down where I had extensive loss of the integrity of the perineal body with the skin intact.

ABDOMINAL PREGNANCY.

DR. WILLIAM N. THOMPSON: This case is one of abdominal pregnancy in a woman thirty-six years of age. It was her first pregnancy and she had no unusual symptoms until well along toward the latter part of her term, when she said she felt something give way. After that she felt no motion and experienced severe cramps, and some hæmorrhage, and passed clots of considerable size. I saw her three weeks after that time and made a diagnosis of abdominal pregnancy, but in endeavoring to check up my diagnosis I had an X-ray picture taken which showed nothing except an ill-defined tumor. There were no pains. The reason, I think, was that the fœtus had been dead two weeks and the bones had begun to degenerate, and also it was well down in the hollow of the sacrum and could not be seen or was overshadowed by the thick bones of the sacrum and symphysis. The woman was operated on, and of course we expected some sepsis. We made the ordinary operation for such cases and drained through the vagina. The patient made a good recovery.

DR. PADDOCK: You say it was an abdominal pregnancy?

DR. THOMPSON: I should have said the fœtus was in the pelvis. The placenta was divided between the open tube, which was spread open a considerable size, and a part of the placenta was spread over the rectum or adherent to the rectum. It could be stripped off. It was disintegrating.

DR. PADDOCK: It was a tubal pregnancy.

DR. THOMPSON: Yes, but at this time it became an abdominal pregnancy.

DR. HOLMES: Could you get the sac out?

DR. THOMPSON: Yes, I could peel it out.

DR. ROBERT T. GILLMORE: With reference to the question of the X-ray in the diagnosis of cases of this kind, it is quite essential that one should have the facilities for having the best kind of X-ray apparatus; also, a very fine radiographer. I have had the experience of trying to have an X-ray made by a man whom I supposed to be competent, and it was diagnosed as a tumor by the radiographer. We were instructed to go ahead and operate, and about two weeks later I delivered the woman of an eight-pound boy. However, I have seen some very fine X-rays made of these cases where the bone-formation was not perfect, and I have seen shadows at from four to six months and they were fine, showing the position of the child, only the work was done by a man who had had considerable experience, and he had one of the finest X-ray outfits that could be had. We cannot depend upon the diagnosis with the X-ray unless we are sure of having the finest X-ray apparatus we can have and a competent radiographer, and one capable of developing these light shadows.

DR. CHARLES E. PADDOCK: I want to emphasize what Dr. Gillmore has said in regard to the character of men who make these diagnoses with the X-ray. Within the past year I have had such a case, a case of pseudocyesis, and a diagnosis was made of pregnancy. The patient was waiting then in the hospital to be delivered. Careful examination under an anæsthetic revealed nothing in the abdomen, but to be sure they were correct an X-ray picture was taken. The X-ray man, according to his decision,

showed me the head of the child. He said he could see it, but I could not, and the woman has not been delivered yet — and it is about a year.

DR. CHARLES B. REED: I would like to ask Dr. Thompson, in reference to this case, whether the child lived after its discharge into the abdominal cavity?

DR. THOMPSON: The woman said after that she felt no motion.

DR. REED: It was a tubal abortion?

DR. THOMPSON: Yes. It was considered to be a tumor by the X-ray man, but I was quite sure it was easy to feel the fœtal head in the vagina.

DR. CHANNING W. BARRETT: In this connection I would like to read briefly the history of a case. The patient is now in the University Hospital.

Mrs. B., aged 36, married sixteen years, has had two children, one fifteen years ago, and one about thirteen years ago. She supposed she had a miscarriage about six or eight years ago; other than that she was absolutely normal in menstruation. She was regular in June, July, August, and September. She menstruated first at the age of thirteen, and her menses were painless. She menstruated October 20th, or October 19th. The flow was slight and without pain. She flowed for a day or two, and then it stopped. It came on again and kept returning in that way without pain, as a little dribble of a flow, until about December 20th. She had nausea and some vomiting, but had been rather given to that sort of a thing for a number of years. She also had some tenderness of the breasts. She concluded she was pregnant. She consulted a doctor who found the uterus somewhat enlarged, but thickening outside of the uterus. Monday before New Year's she passed a clot with some tissue. The nurse found no fœtus with that. She flowed once a week, and then ceased to flow. At the time of passing the clot she had a rather marked pain in the right hip, but other than that she suffered no pain during the time. I was called soon after that and found a mass outside of the uterus, but did not think from the character of the mass and the absence of pain she had an extra-uterine pregnancy. I saw her again about February 11th and made a diagnosis of extra-uterine pregnancy continuing to term, or the fœtus continuing to live. That diagnosis was based upon the fact that the flow from the uterus had entirely stopped, and the mass kept on increasing without pain in the abdomen. We operated February 15th and found a pregnancy continuing. There was no free blood in the abdomen. The omentum was pushed back, the appendix tipped down into the pelvis posterior to this, and the rectum was very much crowded by the mass. The tube was very much enlarged at the outer end. The placenta was still attached largely to the end of the tube and in the end of the tube. Reaching down posteriorly the membranes were all that separated it from the posterior wall of the pelvis and the rectum. That was easily broken. An oval mass was largely in the peritoneal cavity, but the placenta was still attached to the tube. It was a tubal pregnancy, with hardly a complete rupture of the tube. It was more of an abortion, and the tube ruptured. After lifting out the fœtus a mass nearly as large as one's fist appeared below that, and upon lifting that out it broke off from the posterior layer of the ligament: it was a dermoid of the ovary. That is, I took it to be that without cutting it open. I recall in this connection a specimen that was exhibited as an abscess from the ovary, but when it was cut open it was found to be a dermoid, and this may be the opposite of that. However, I take it to be a dermoid. The appendix was very much enlarged, and about six inches long, and when removed there was about the same length of the fœtal membranes attached to the appendix. This fœtus was still alive and the heart continued to beat 15 minutes after its removal. It was only about a four-month fœtus. It was not as large as the one Dr. Thompson has shown. This patient is making a good recovery. In this case we drained close to the inguinal region.

DR. ROBERT T. GILLMORE: In regard to the nomenclature of tubal abortion and tubal rupture, I am inclined to think that Dr. Reed's conception of tubal abortion and tubal rupture is a little confused. Tubal abortion is where it comes from the fimbriated extremity of the tube, and wherever there is rupture of the tube in such a slight manner it is a tubal rupture, and tubal abortion is only possible in the early months of pregnancy — in other words, when it can go through the fimbriated opening of the tube — and after about three months it is an impossibility, and then you usually get a rupture.

DR. MARK T. GOLDSTINE: I would like to ask why these cases were drained? They were clean cases to start with.

DR. THOMPSON: I felt it was better to be on the safe side, and so I drained in my case. There was a leukocytosis of 20,000, and there was considerable of an abscess discharged from the vagina about a week afterward. The temperature was elevated at the time I operated.

DR. CHANNING W. BARRETT: I drained my case in order that the patient might live. After removing a pregnancy which has continued to that extent, there is certainly always a good deal of abraded and oozing surfaces, and there would be an accumulation of blood in the abdomen if drainage was not resorted to. That would almost be inevitable. I would rather have the blood outside than inside the abdomen. The vessels were tied. The drainage that took place afterwards showed there was quite considerable fluid in the abdomen.

DR. REED: Was there anything but blood in the abdomen?

DR. BARRETT: I do not think there would be any fæces or pus.

DR. REED: Would you drain for blood?

DR. BARRETT: Yes, if there was a considerable amount of it.

DR. A. BELCHAM KEYES: We have a right to speak of internal rupture of the tube where that portion of the tube which contains the fœtus ruptures into the lumen of the tube and the blood

passes out of the fimbriated extremity and perhaps towards the uterus. It is termed internal rupture with or without escape at the fimbriated extremity of the fœtus, with or without abortion. External rupture is where it penetrates straight through the tubal wall and peritoneum into the peritoneal cavity; and thirdly, we may have a combination of these. As I understand, this was a ruptured tubal pregnancy, with tubal abortion, and secondary adhesions in the abdominal cavity. Had this rupture gone through the wall, we know that when we open these cases we find nothing running up to the fimbriated extremity. In rare instances the fimbriated end may be closed by adhesions and a rupture through the tube wall into the peritoneal cavity is called an external rupture.

Dr. William M. Thompson read a paper entitled "Influence of the Thyroid Gland on Pregnancy and Lactation." (See page 226)

DISCUSSION

Dr. George F. Dick was asked to open the discussion. He said: I have not done any work on the thyroid, but this paper has been exceedingly interesting to me in connection with some work that I and my associate did on the function of the corpus luteum, and particularly the case he mentioned where pregnancy terminated and there was apparent absorption of the embryo about the fourth month. There was an idea advanced by Frankel that the corpus luteum was necessary for the continuance of pregnancy up to about the first half, and our work was a confirmation of that. This case Dr. Thompson reports is of interest as it indicates that there may be a mutual intercompensation; that is, where there was a deficiency of thyroid function it would result in the same way as if there was deficient function of the corpus luteum.

I think the remainder of the paper, particularly the case reports, is particularly interesting to anyone who is interested in experimental work, because such work is hard to preduce experimentally. Rabbits were worked on by us in which the ovaries were removed, and he was unable to show any change in the thyroid, but such changes are hard to demonstrate.

Dr. N. Sproat Heaney: I was much interested in Dr. Thompson's paper, the more so since recently peculiar changes in the liver, resembling those found in eclampsia, have been described as occurring after the removal of the parathyroids in animals. In experimental work on the thyroid in dogs it is impossible to eliminate the rôle of the parathyroids since one cannot attempt a complete thyroidectomy without injuring the parathyroids. In those dogs of Dr. Thompson's which showed tremors and convulsions the parathyroids must have been severely damaged though left in situ, since those dogs had tetany, which is a parathyroid trouble. As a matter of fact, there is much reason to suppose that more depends upon the integrity of the parathyroids in pregnancy than upon the thyroid gland itself.

Dr. Charles S. Bacon: I appreciate the experimental work that Dr. Thompson has done and also his review of the literature, which is valuable; and I think it is unnecessary to compliment him further than to say that such work is always appreciated. But I want to make one criticism. He has reported a case of interruption of pregnancy, apparently a retrogression of the pregnancy that had advanced, if I remember rightly, three or four months after the removal of one of the lobes of the thyroid, and in such a way as to give the impression that that was due to this operation. That is a most astonishing fact, if it is a fact, and if that is the right explanation I think it is of so much importance that it should have been reported with greater attention to detail. We should have been given positive evidence that pregnancy did exist. We should have been given evidence that the pregnancy was disturbed in that way. I do not know that there has ever been a case like that reported in the human subject. If so, they are rare.

Dr. Channing W. Barrett: There are a few clinical points I would like to bring out in this connection in relation to the interesting subject of the thyroid connected with pregnancy. Bearing upon the case which Dr. Bacon comments on, I will say that during the last year I operated, on the West Side, upon a case of hyperthyroidism during pregnancy. The patient had the right lobe, which proved to be a double lobe, enlarged very rapidly during pregnancy. It had caused hyperthyroidism, so that there was great rapidity of the heart-action which had not yielded to the treatment of the doctor who had her under observation. The thyroid gland reached considerable size, so that it was compressing the trachea considerably, and the patient was having difficulty with respiration. The two lobes were removed. The patient continued to term without any difficulty. There was no evidence that abortion was threatening or anything of that kind, nor while the patient was yet in the hospital, she leaving the hospital in a little less than two weeks, with the pulse quieted down considerably.

In relation to enlargement of the thyroid with

a gynecological condition of the tube, I was called to see a case of hyperthyroidism with a retrodisplacement and adhesions of tubes and ovaries. The thyroid gland was considerably enlarged, but not sufficiently so to compress the trachea. The condition of the thyroid gland rapidly subsided after the correction of the pelvic condition. We see these cases subside so frequently under other conditions that this may not have any great weight.

Another patient who had an enormously enlarged thyroid developed some symptoms of hyperthyroidism during pregnancy, but these were not very marked, and she continued to term without any interference. That woman gave a history that her mother also had an enormously enlarged thyroid gland. Her grandmother saw the child which when born showed considerable enlargement of the thyroid gland, so that it embarrassed the respiration of the child considerably, yet in seeing the child a number of months later the thyroid gland had gone down to nearly normal size and gave no trouble.

DR. GEORGE SCHMAUCH: I am glad to see that there are many other members interested in Dr. Thompson's paper. I have formed my own opinion about the thyroid. A great deal of misunderstanding comes, as I think, from the fact that so many physicians do not understand hyperthyroidism. The thyroid itself is nothing more than any other gland or organ, and if you connect hyperthyroidism with hyperactivity of this gland, it is natural that such an organ can only be sufficiently active for a certain span of time.

Like Dr. Bacon, I think Dr. Thompson's case is extremely interesting. It is one of the few cases reported in that line where pregnancy has been interrupted by operation on the thyroid. But I have come to the opposite conclusion, which is that the thyroid is absolutely necessary to keep up healthy pregnancy and the health of the child. The same conclusion I would come to with regard to the experiments on dogs. In a number of these dogs where he left a part of the thyroid, this part must have been extremely active; otherwise the dogs would have aborted. The thyroid was so elastic that it could make up the loss and go on functionating although the demand on this gland is greatly increased during pregnancy. In regard to the relation between thyroid and menstruation, I also differ somewhat from Dr. Thompson. The thyroid brings on and keeps up menstruation; menstruation is impossible without the thyroid.

The conclusions we come to, regarding the thyroid, are based on clinical experience by feeding thyroid extract. In a real case of hyperthyroidism you will make the patient worse by feeding her thyroid. Insufficiency in the later stages, however, shows the same symptoms as activity of the gland we find the same tremor, the same palpitation of the heart, and the same emotion. In most cases of hyperthyroidism, we do not deal with primary hyperthyroidism; it is a secondary hyperthyroidism brought on by faulty metabolism or bacterial toxins. These are the patients that get well by feeding thyroids, although they have all symptoms of hyperthyroidism.

The reason why gynecologists have not taken up this subject more thoroughly is because it became the domain of surgeons, though most of these patients are women. The reports we get from surgeons are not as reliable and complete as they might be. They never tell about myxœdema, amenorrhea, and such conditions that follow extirpation of a part of the thyroid gland years afterwards. French authors have drawn attention to a fact I have observed myself, that in many cases pregnancy is able to cure asthma, to cure chronic rheumatism, and many other ailments by the hyperactivity of the thyroid. This proves not only the increased secretion of the thyroid during pregnancy, but also its powerful influence on the general metabolism. Secretion in the thyroid is merely a functional phenomenon. This glandular function depends on climate, nourishment, and central influences. The plain logic demands an insufficiency, following sooner or later the surgical diminution of the thyroid.

DR. MARK T. GOLDSTINE: Just a word or two about the thyroid gland in dogs: I do not see how you can make a comparison between the human subject and a bitch who gives birth to puppies time and again. A female dog that has enlarged thyroid glands, even very marked enlargement, may live for many years and never show any symptoms of it. Such an animal will give birth to puppies probably as frequently, if a thoroughbred, as an ordinary dog will. The only influence that the enlarged gland seems to have on the puppies is that they are not as good dogs as you probably get from a female dog who did not have an enlarged thyroid. We had a dog in Chicago, the finest female dog ever bred in this country. Her grandfather was Major McKinley, owned by General Thomas, on the North Side. I watched her for ten years. She had seven litters of puppies and all through these she had an immense thryoid. We never got a

good puppy out of that dog. We got about 40 or 42. There was another dog, Olive Denbigh, who took the first prize for setters. She took first prizes at most of the bench shows. This animal was bred to the finest Gordon setters that could be got and supposed to give the finest dogs. She had three litters of puppies, but we never got a good puppy from her. They were bow-legged, and knock-kneed and cross-eyed. The colors were not right. She died of exophthalmic goiter. Before she died she had marked exophthalmis; she had tremor, etc. This is the only female dog I have watched — and I have watched many of them with enlargement of the thyroid — that ever died a death that was at all typical of exophthalmic goiter. I could enumerate other cases in the same way. The enlarged thyroid in male dogs does not have any effect whatever, or at least it does not seem to. I have one dog which has an immense thyroid for his age, and so far the animal has not shown any symptoms. Whether the influence of the enlarged thyroid on the puppies is because they have a mighty poor soil on which to grow or not, I cannot say. But patients with enlarged thyroid are mighty sick patients. You will get so many of them if you examine them carefully. As to dilated heart, you get that sometimes in the female dogs. You get a much larger heart than usual.

As regards operating on the thyroid gland, it is a bad operation on any dog. If you operate on a male dog and remove a part of the thyroid or most of it the dog usually dies. It is the same on the female dog. I have been interested in watching high-grade female dogs for many years, and I have yet to see a female who has puppies that come up to expectations. I have a friend on the North Side who has a dog we are watching, a high-bred brindle bull bitch with a large thyroid, who is going to have puppies very soon. The sister of this animal died of dystocia. She had a thyroid quite large and could not throw her puppies; she died when it came to birth. What will happen to this one we do not know. But if she has the high-grade puppies as she ought to have from the breeding it will be a surprise.

Dr. N. Sproat Heaney: Prof. Carlson, of the University of Chicago, has made observations corroborative of those just now related by Dr. Goldstine. He further observed that when the mother's goiter was of such a nature that the thyroid activity was deficient the pups were uniformly goitrous but that normal puppies were born when the goiter caused no thyroid insufficiency. He thought that this might be explained upon the basis of a compensation — that the pups' thyroids hypertrophied to supply the deficiency of the necessary thyroid substances in the mother. He feels that he has proved this hypothesis experimentally by removing portions of the glands of pregnant bitches and securing puppies with hypertrophied thyroid glands.

Dr. George Schmauch: I am familiar with the literature on this subject, and so far as I know there is only one case reported of Basedow's disease in a dog. That experiment has been made dozens and dozens of times, and no one has been able to bring on real exphothalmus connected with hyperthyroidism. All these dogs the doctor told us about are insufficient, and I venture to say that if he will feed his dogs with bone they will raise nice puppies without any insufficiency at all.

Dr. Rudolph W. Holmes: In regard to the case reported by Dr. Thompson of partial enlargement of the thyroid and diminution in the size of the uterus, I will say that a year ago I had a patient whose case was of considerable interest.

A woman came to me in December, who had been married six or seven weeks, and had never menstruated since marriage. The uterus was characteristically softened, was enlarged, and she was beginning to have nausea. She had one or two attcks of emesis; the breasts were enlarged, the areolæ were discolored, and we got colostrum. I followed her along the next month and thought she was about ten weeks pregnant. I followed her along the succeeding month until I thought she was about fourteen weeks pregnant, the uterus becoming symmetrical. She had the characteristic signs of pregnancy continuing, and when it came to the next period she said she passed a few drops of blood. I examined the uterus and thought it was about the size of a ten weeks' pregnancy. She came back again and had no "spotting" of blood, and I examined her to see whether she was pregnant or not. The nausea had subsided and the colostrum ceased. She is now four months pregnant, it being her second pregnancy. Whether she ever had signs of any secretion or whether something happened to the corpus luteum about the fourth month that produced this retrogression, I do not know.

About three months ago a woman came to me who had been under the care of one of our experts on tuberculosis for the treatment of incipient tuberculosis. She had been married about two years. She came to me in the sixth month of pregnancy. She had missed six periods. I examined her and found she had made a mistake, that she was only about three months pregnant. The next month she came to me. There was no enlargement of the uterus. She had slight characteristic symptoms of pregnancy; a little nausea without any emesis; the breasts were enlarged and tender; the areola was discolored and there was colostrum. I told her she made a mistake of three months, and I commented to the interne that even if the uterus had not increased in size there was something wrong: there was probably the death of the embryo. She went home after the second visit, when she was about seven months pregnant, and two or three days later she passed a little blood. She came back and stayed in the

hospital about a week. There was intermittent bleeding, not very profuse, but still it was persisting, and the uteru was smaller, and then she began to have a little colic, and I thought the best thing was to empty the uterus. There was a mass of necrotic placental tissue found. The membranes were not found and unfortunately perhaps we would not have found anything anyway. The débris was so necrotic that I threw it away. She did not have anything wrong with her thyroid, and I thought possibly that it was a coincident, as it was in Dr. Thompson's case, that there was this retraction.

DR. THOMPSON (closing): I appreciate the indefiniteness of the experiments I have related to you. I referred the tissue to a pathologist who told me whether I had parathyroid or thyroid tissue. I found it so very difficult to deal with the parathyroids in rabbits that I turned to dogs. It is easy enough to locate the right and left lobes of the thyroids, but the isthmus is such a delicate structure I could not get all of it. Beneath it I did not get all the parathyroids in the cases related, but I concluded that I had damaged the tissue so thoroughly that it ceased functionating.

I was very much interested in the remarks of Dr. Dick, and I am sorry he did not go into the subject more explicitly.

Dr. Heaney speaks of the difficulty of this operation and I coincide with him in regard to it. After considerable practice in handling dogs and examining them we get a little different technique from what is ordinarily employed in the operating room, incising the skin in the median line, and with the finger dissecting the muscles and feeling the thyroid. Where it is hypertrophied it is easy enough. The thyroid varies more in dogs than I had any idea of.

With reference to the remarks made by Dr. Bacon about pregnancy being interrupted, I should have been more careful in my statement, and it may be a coincidence. It happened at that time. The woman had all the evidences of pregnancy. She had an enlarged and softened uterus; she had the areola discolored; she had the line in the center of the abdomen and had nausea. I delivered this woman of a future pregnancy, the child being healthy, so I was able to watch the remaining thyroid, which hypertrophied immensely at the next pregnancy.

DR. SCHMAUCH: Did she have any children before that?

DR. THOMPSON: No. I agree with Dr. Schmauch in regard to the thyroid influencing menstruation. I have collected a good many reports on the influence of the thyroid on menstruation, but it was not possible to include them in a paper of this character. There is no doubt about it: We do not appreciate the slighter variations in the function of the thyroid in pregnancy and in diseases of the pelvic organs, the ovaries, etc. I feel, for my own part, from the slight observations I have made, that hereafter I shall make examinations of the thyroid in a routine way in every case of pregnancy and in every gynecological patient.

BOOK REVIEWS

MALFORMATIONS AND CONGENITAL DISEASES OF THE FŒTUS. By R. Birnbaum, M. D. Translated and annotated by G. Blacker, M. D., F. R. C. P., F. R. C. S. Philadelphia: P. Blakiston's Son & Co., 1912.

In this new volume the author has attempted to arrange systematically the facts relating to the various malformations and the congenital diseases of the fœtus. While this material may be found scattered throughout different text-books, manuals and monographs, it is certainly an advantage to the student and practitioner to have it assembled in such a convenient form as this. While the entire subject has not been exhausted, the material as here presented, together with the complete bibliography, more than supplies the pre-existing deficiency.

The causes of malformations are to be explained by one of these three factors: (1) The germinal factor, in which is found the explanation of twins and double monsters, and the transmission of inherited malformations; (2) the action of the amnion; (3) changes in the nutrition, whether the causes of this are to be found in the action of the amnion, or in the influence of certain chemical bodies, toxic or otherwise. In his classification the author forms two groups, single and double. Under the single group are: (1) malformations due to arrest of development, (2) those due to excess of development, (3) those due to errors of development, (4) those due to displacement of tissues and persistence of fœtal structures, and (5) those due to fusion of sexual characters. In the second group he acknowledges difficulty, and reproduces previous classifications by Förster, Taruffi, Ahlfeld, Marchand, and Schwalle.

Chapter 2 includes maceration, mummification and dwarfs, while Chapter 3 treats of spina bifida, with a carefully arranged differential diagnosis. Defects of the skull-cap, hydrocephalus and malformations of the face and its congenital diseases are also discussed.

The thymus gland and goiter are considered under malformations of the neck, and an excellent classification of the abnormal disposition of the various anatomical portions of the heart is offered. Congenital diaphragmatic and umbilical herniæ, intestinal occlusion, and atresia ani are next taken up. One of the most interesting discussions is that devoted to hermaphroditism, where a logical classification is presented and the legal aspects of the subject briefly entered into. This legal phase is again approached by Birnbaum in his discussion of monsters and of the pygopagi.

Throughout the text, Birnbaum, as a gynecologist, treats the obstetrical side of the question as of most importance, and in greatest detail next to the anatomical and pathological. This tendency is demonstrated particularly in considering defects of the skull, in hydrocephalus, and in double monsters.

The translation is entirely satisfactory, and Blacker has very aptly added many notes to the original work, partly explanatory and partly new material. The volume fills a gap in obstetrical literature, and we are indebted to the translator for an excellent English version.

CAREY CULBERTSON.

A TEXT-BOOK OF GYNECOLOGY. By William Sisson Gardner, M. D. New York and London: D. Appleton & Co., 1912.

The limited time of the overcrowded medical student has been held in mind in the preparation of this volume by Dr. Gardner. Hence essentials have been grouped with brief explanation, and clearness has been aimed at. The numerous rarer diseases have been considered in a few words, and many general surgical subjects usually presented in gynecological text-books are here omitted. The technical side of various operative procedures is but briefly stated, while more space is given to diagnosis and to the commoner diseases with which the student should become familiar. Thus the author has covered the field of gynecology in the short space of 271 pages, and at that the text does not appear crowded. On the contrary the type is large and clear, with sub-headings readily caught by the eye; the margins are generous, while illustrations are frequent. Of these latter the line drawings are clear and illustrating, while gross and microscopical specimens are well demonstrated in reproductions from photographs and photomicrographs.

The author presents his topics according to the anatomical classification, again the most practicable scheme for the medical student. Thus diseases of the vulva and the vagina are first considered, then injuries to the pelvic floor, urinary fistulæ, and diseases of the urethra and bladder. Likewise, chapters are grouped together covering the uterus, its displacements, the cervix, the endometrium, then malignant and benign uterine tumors. Following diseases of the tubes and the pelvic cellulitis comes extra-uterine pregnancy. Diseases of the ovary, ovarian cysts, and solid tumors of the ovary and of the broad ligaments are last in line.

A valuable chapter on technique, and one each on post-operative complications and post-operative

treatment complete the volume, save for the carefully prepared index. The author feels that enough has been given on each subject to constitute a thorough presentation of it, and that, in its brevity, the text thus best fulfills his aims in preparing the field of gynecology for the student.

CAREY CULBERTSON.

THE INTERNATIONAL MEDICAL ANNUAL. New York: E. B. Treat & Co., 1913.

The International Medical Annual for 1913 fills a long felt want in medical literature by placing before the profession all of the latest information of the preceding year in all departments of medicine and surgery. In addition to the department on therapeutics and the discussion in full of disease and operations which were found in the previous volume, the volume for 1913 contains a glossary of the newer phraseology of medicine and surgery. The book is fully illustrated with reproductions from X-ray plates, with photographs, and with line drawings, all of which greatly facilitate the assimilation of the reading matter.

EUGENE S. TALBOT, JR.

DISEASES OF CHILDREN. By B. K. Rachford, M. D. New York and London: D. Appleton & Co., 1912.

As would be expected, this book is especially good upon the functional nerve diseases of children, as it is in nerve conditions generally. The first section on hygiene, growth and development, examination of the sick child, and therapeutics of infancy and childhood, contains much which will be found of great value.

The portion on infant feeding is confined largely to the ideas advanced by those following the percentage method, and hence does not give as definite conclusions as the later developments on the subject would seem to justify. The book is concise and well arranged. The pictures are most of them original.

C. G. GRULEE.

GENITO-URINARY DISEASES AND SYPHILIS. By H. D. Morton, M. D. Philadelphia: F. A. Davis Co., 1912.

The author has brought this edition down to date. The information added is accurate and sufficiently explicit for both practitioners and students. The treatment of bladder tumors, newer diagnostic methods employed in kidney diseases, the treatment of syphilis with salvarsan, the discussion of the Wassermann reaction, and many new illustrations have been added. Gonorrhœa and its complications are treated with detail and modern methods of treatment are reviewed. However, the vaccine and serum treatment for genito-urinary diseases, as well as some other points, has received but scant attention. This is but natural, considering there is but one volume. On the whole, the book can be recommended.

L. E. SCHMIDT.

OBSTETRICS, THE PRACTICAL MEDICINE SERIES. Vol. V. Edited by Joseph B. DeLee, A. M., M. D., with the collaboration of Herbert M. Stowe, M. D. Chicago: The Year Book Publishers, 1912.

This yearly review of all that is worth while in the progress of obstetrics is a convenient and useful grouping of up-to-date matter for the use of the accoucheur. It is interesting to note such a topic as the use of salvarsan in obstetrics and to learn that the results have not been altogether desirable — in fact, that it exposes the fœtus to considerable danger to inject salvarsan into a pregnant woman. The blood-serum treatment of the toxæmia of pregnancy appears to be yielding good results, and the editors of this book endorse its administration in severe cases. The editorial comments throughout the book are conservative and in line with the accepted teaching of the day. Books of this kind have a value in indicating where the good literature may be obtained, thereby saving much valuable time in the search for the real progress in the subject-matter under discussion.

PHARMACOLOGY AND THERAPEUTICS. H. C. Wood, Jr. Philadelphia: J. B. Lippincott Co.

The title of this work is somewhat of a misnomer, as it is really a text-book of materia medica, to which have been added brief statements and discussions on the pharmacology and therapeutics of the drugs considered.

The classification is an improvement on the ones commonly made, the author having grouped drugs according to their general action; e. g., drugs used to affect the secretions, drugs used to affect the nervous system, drugs used to affect the circulation, etc. This permits a discussion of the pharmacological action of each sub-group as a whole. Animal experiments and tracings are cited to demonstrate the action of many of the more important group members.

Dr. Wood's remarks upon therapeutics are particularly worthy of praise, for, on the one hand, he does not neglect to explode many therapeutic fallacies, while on the other, he is positive, but at the same time conservative, in his statements concerning the value of the active drugs and the indications for their use.

The only criticism, and it is a minor one, is in regard to a few brief sections on treatment; e. g., treatment of acute bronchitis, treatment of chronic heart disease, treatment of malaria, etc. It seems to the reviewer that these are outside the scope of the book. They are not complete enough to be of much value, and impress one as being superfluous.

There is an introductory chapter on prescription writing, mode of action of drugs, etc.

The book bears the stamp of authority, and can be recommended as a practical text on materia medica for students and as a reference book for practitioners.

JAS. F. CHURCHILL.

THE FRIENDS OF THE INSANE, AND OTHER ESSAYS. By Bayard Holmes, M. D. Cincinnati: Lancet-Clinic Publishing Company.

Anyone interested in the sociological problems of caring for the insane, in the study of the pathology or cure of insanity, or the condition as a domestic problem, can well afford to read every page of Dr. Bayard Holmes' Essays on The Friends of the Insane.

Those who are acquainted with Dr. Holmes' lucid style in stating fearlessly his views will not fail to see that their friend has struck twelve in this literary effort, and all those who are privileged to dip into the volume at all will be charmed and stirred by a new discovery. We take pleasure in this instance, in breaking our rule to exclude all but strictly surgical books from our review department, to give a few terse quotations from this work of Dr. Holmes in order to induce the reader to peruse the book in its entirety:

"It has seemed very unreasonable, not to say cruel, that the insane are cared for by the State, not for their own good, but as Dr. George Webster, President of the Illinois State Board of Health, once said at a banquet of a medical fraternity, for the good and safety of the sane. Millions are spent in custody, but not a dollar in cure, not a dollar in research. . . . For every thousand dollars spent in custody ten dollars ought to be spent in research. Economy might dictate that even a hundred dollars out of each thousand should be spent in research and cure. As it is, absolutely no effort is made by any department of State to shut off the need of an expense for custody of the insane, which is as much a burden to industry as a perpetual war. . . . It is my belief that this work of investigating the causes of insanity should be carried on by the university. The problem seems to be one of biologic chemistry. The chemical libraries and trained chemists and biologists are already crowded about the university. . . . The insane themselves cannot, for various and obvious reasons, present their claims. The friends of the insane have never been organized for their own protection, education and consolation. There seems to be a strange isolation in the fact of insanity in the household. For death and for the bereaved by death there is ostentatious sympathy and consolation from friends and strangers and the world of literature. For the bereaved by insanity there is a fateful silence and turning away. . . .

"There is no state institution where adequate encouragement is provided for the study of the causes of insanity or of the conditions of parasitism, hæmology, nutrition and metabolism during the course of the disease. There is no state in which the insane are available for demonstration to medical societies and medical students. The ordinary means of studying insanity which medical men have in studying all other diseases is taken away from the medical profession by law, and no other provisions are made at all commensurate with the importance and the complexity of the problem. . . . The courts should be provided by the friends of the insane with a questor or advocate for the insane, whose duty it should be to call the attention of the court to such evidence as might early lead to the treatment of cases of incipient insanity, such as the State now provides, and thus save the judiciary from the bungling decisions which so often confound officers of penal institutions.

"When insanity comes to a household, there is nothing too expensive to be undertaken. The private sanitarium is recommended by alienists because the family dread and are terrified by the state institutions. . . . Those who look upon surroundings of luxury as more important than the researches which reason dictates will always patronize these places, where brass door knobs and Brussels carpets take the place of bolts and bare floors. If a small part of the largess poured out on the unsanitary, unnecessary and unappreciated display of the private mad-houses was devoted to research, something could be accomplished by private initiative, and that promptly."

THE HEALTHY BABY. By Roger H. Dennett, M. D. New York: The Macmillan Company, 1912.

This book, intended for the laity, strikes one with its clear common sense. Many points about which the physician dealing with children is so constantly questioned are answered clearly and satisfactorily in this volume. It seems a book which can be safely placed in the hands of the laity. One may differ slightly from the author in the question of the intervals between feedings, and perhaps the composition, but on the whole the book is conservative and very practical. C. G. GRULEE.

HERSELF (Talks with Women Concerning Themselves). FALSE MODESTY. CONFIDENCES. TRUTHS. By E. B. Lowry, M. D. Chicago: Forbes & Co., 1912.

This series of four books is presented to the public in response to the crying need for fundamental knowledge regarding sexual development and hygiene.

Advanced thinkers and teachers agree that these subjects should be taught in public schools, and indeed they are taught in many; but it is difficult to present these subjects to pupils in a beneficial way, just because the teacher is a stranger and does not enjoy the close confidence required of such a teacher, and second, the pupil has previously been perniciously taught many things by his or her older associates and is wont to lightly consider the subject when presented in a public manner.

The object of the author in this series is to obviate these difficulties by instructing the parent and guardian how to present these vital subjects to the children, to read the text with them and explain it to them. The volume concerning women is valuable in that it presents in simple language the physiology and hygiene of the sexual organs, regarding which gross ignorance prevails. The books can be highly recommended. H. A. POTTS.

Clinical Congress of Surgeons of North America

FOURTH ANNUAL SESSION

CHICAGO

NOVEMBER 10 TO 15, 1913

CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

EDWARD MARTIN, President — W. W. CHIPMAN, Vice-President-Elect
GEORGE E. BREWER, President-Elect — FRANKLIN H. MARTIN, General Secretary
ALLEN B. KANAVEL, General Treasurer
A. D. BALLOU, General Manager

COMMITTEE ON ARRANGEMENTS FOR THE CHICAGO MEETING

E. WYLLYS ANDREWS, Chairman

FRANK T. ANDREWS
CHARLES S. BACON
W. L. BAUM
CARL BECK
JOSEPH BECK
FREDERIC A. BESLEY
ARTHUR DEAN BEVAN
LEWIS W. BREMERMAN
TRUMAN W. BROPHY
JAMES H. BURRY
H. R. CHISLETT
WM. R. CUBBINS
CHARLES DAVISON
JOSEPH B. DELEE
PHILIP S. DOANE
W. A. NEWMAN DORLAND
DANIEL N. EISENDRATH
JACOB FRANK
ROBERT T. GILLMORE
THOMAS L. GILMER
D. W. GRAHAM
A. E. HALSTEAD
T. MELVILLE HARDIE
M. L. HARRIS
L. HEKTOEN
CHARLES E. KAHLKE
ALLEN B. KANAVEL
DEAN D. LEWIS
GEORGE P. MARQUIS
FRANKLIN H. MARTIN
L. L. MCARTHUR
FREDERICK MENGE
JOHN B. MURPHY
ALBERT J. OCHSNER
J. R. PENNINGTON
NORVAL H. PIERCE
JOHN L. PORTER
HOLLIS E. POTTER
EDWIN W. RYERSON
LOUIS E. SCHMIDT
W. E. SCHROEDER
D. A. K. STEELE
GEORGE F. SUKER
THOMAS J. WATKINS
J. CLARENCE WEBSTER
WM. H. WILDER
CASEY A. WOOD

CHICAGO AS A MEDICAL AND SURGICAL CENTER

III. THE HOSPITALS OF CHICAGO

BY JOHN A. HORNSBY, M. D.

IN the United States there are approximately 6,650 hospitals, aggregating more than 600,000 beds; in Chicago there are 103 hospitals with approximately 10,000 beds.

The present era in hospital building and administration came upon Chicago with a great suddenness, and the original cause was an intense shock. When the Iroquois Theater burned in December, 1903, with a loss of about 600 lives, the community was tremendously shocked, and the subsequent investigation developed the fact that nearly all the hospitals in Chicago were fire-traps and it was only luck or providential interference that some such calamity had not happened to any number of them. The awakening came, however, and was first manifested by the passage of most rigid building and hospital laws. Boards of directors in hospitals all over the city began to work out plans for new institutions or for the entire reconstruction of their old buildings.

As a result of this new era, the years 1907 and 1908 ushered in several splendid hospital buildings, the first of these being Michael Reese, closely followed by St. Luke's, Mercy, Wesley, Presbyterian, Alexian Brothers, St. Joseph's, St. John du Padua, St. Mary's of Nazareth, Englewood, Ravenswood, and a number of others. Up to that time the Henrotin Hospital, a private institution on the North Side of the city, erected by the late lamented Dr. Fernand Henrotin, was perhaps the best type of modern hospital equipment and administration.

THE NEW COOK COUNTY HOSPITAL

This is the first time in the history of Chicago that the Cook County Hospital may appropriately have a place in the discussion of modern hospitals. The old hospital was and is to-day a disgrace and however efficient an administration may be it is impossible to give patients an up-to-date service in a heterogeneous, illy-planned,

The new Cook County Hospital, showing administration building now nearly completed.

badly constructed and badly arranged group of buildings, with wards for a hundred or more patients, and in every way wholly out of keeping with modern methods of caring for the sick.

When the members of the Clinical Congress of Surgeons of North America visit Chicago this fall they will find a new era and a new impetus in hospital activities, the chief inspiration for which will be the new Cook County Hospital.

Under a bond issue of $3,000,000, a building is under construction which is supposed to cost $2,272,000. Because of bad management, great wastefulness and extravagance at points that might well have been extremely plain, and niggardliness in arrangements for the actual care of the sick, this hospital is now to cost quite a million dollars more. But whatever may be said as to the mistakes of the past, the Cook County Hospital is to be one of the foremost institutions in this country and when completed will house approximately 5,000 patients.

The sections now under construction consist of an administration building 560 feet long and about 50 feet wide, with two wings about 200 feet deep, each seven stories high. In this building will be the admission department, the visiting department, nine operating rooms on the eighth floor, two of which are to have amphitheatres to seat about 200 students each, and the other seven operating rooms to have seating capacity for sixteen students each.

The X-ray department will occupy 5,000 square feet of space, with an equipment of two 75-ampere interrupterless transformer machines, a coil for treatment work, vertical and horizontal fluoroscopic screens, and all the latest accessories of modern X-ray work.

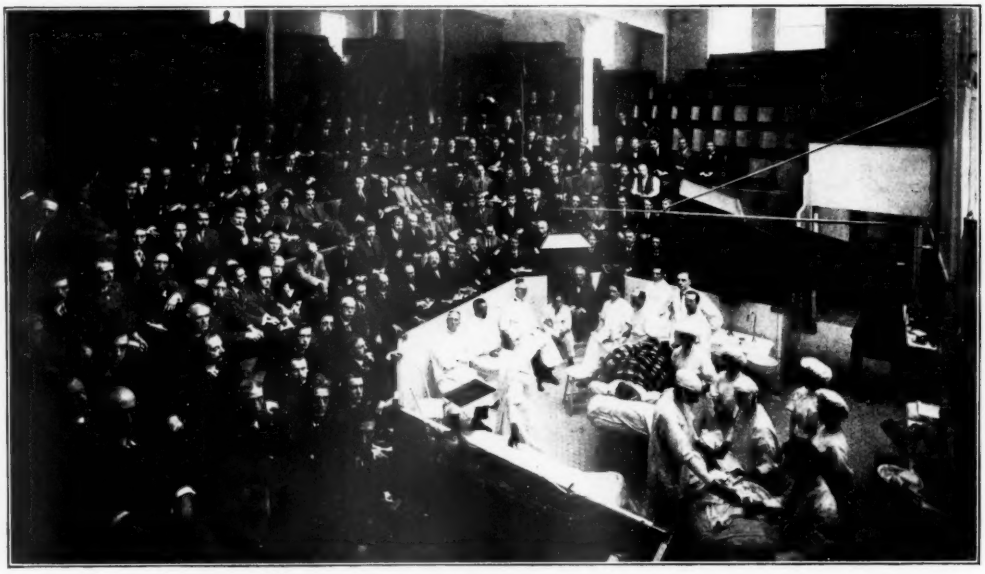
The sterilizing plant for surgical service will consist of a battery of six 16 x 60 dressing sterilizers and three 24 x 36 dressing sterilizers, the former to be used for the sterilization of drums, it being the intention to employ that method of handling sterilized material for all operating and dressing room purposes. In this department will also be one large salt solution sterilizer, the intention being to keep the whole sterilizing plant under the direction of an expert in this field of surgical work.

The water supply for the use of the surgical operating units has been very carefully arranged, the committee appointed for the purpose finally selecting sterilized water treated at 15 pounds pressure, 250 degrees Fahrenheit, for the doctors' and nurses' scrub rooms, and each of the nine operating rooms will contain its own ten-gallon water sterilizers, this to avoid the carrying of sterile water through long distances in pipes.

As soon as the county can obtain further funds to carry on its construction work two other wings will be added to this building and still later another complete building which will duplicate the one now under construction.

MICHAEL REESE HOSPITAL

Of the private hospitals in the city the Michael Reese Hospital is the largest, having accommoda-



Dr. Murphy's Clinic at Mercy Hospital during the first session of the Clinical Congress of Surgeons of North America, November, 1910.

University Hospital — Ogden Avenue and Congress Street.

Michael Reese Hospital — Twenty-ninth Street and Groveland Avenue.

tions for more than 500 patients. The main building of this institution was completed in 1907, is of fire-proof construction throughout and because it was one of the first of the newer hospitals, and perhaps for other reasons, it has been the subject of great interest to visitors from all parts of the world.

In connection with this institution there is a laboratory of pathology which was the gift of Mrs. Nelson Morris and cost $250,000. The plans for this pathological institution have been copied in many parts of the country.

Still another building of this group is the Sarah Morris Hospital for Children, a new building that would be well worth a visit because of the incorporation in its architecture and equipment of what its board of trustees conceived to be the very latest approved material and design. This building contains 125 beds, including observation wards, a surgical department, isolation suites, and separate places or pavilions for infants and larger children of both sexes. Its milk station is one of the interesting features.

There has been added to this group a two-story, four-suite isolation building for the care of communicable infections that develop in the institution. There are unique features in this building, the intention being to perform a large part of the isolation of patients through architectural arrangement. The suite for each infection is entirely separate from the other suites and the entrance to each is from the outside and not through a common corridor.

PRESBYTERIAN HOSPITAL

This institution, one of the finest, wealthiest, and most carefully managed in the city, is now

Sarah Morris Hospital for Children — Twenty-ninth Street and Groveland Avenue. In connection with Michael Reese Hospital.

Mercy Hospital — Twenty-sixth, Calumet and Prairie Avenues.

about thirty years old and has accommodations for approximately 300 patients. Its connection with Rush Medical School, and the performance of nearly all its medical and surgical work by the famous teachers in this institution, give the Presbyterian Hospital an added importance. Recently, through rich endowments, a new pavilion for private patients has been added, in which are incorporated some of the finest features of modern hospital architecture.

MERCY HOSPITAL

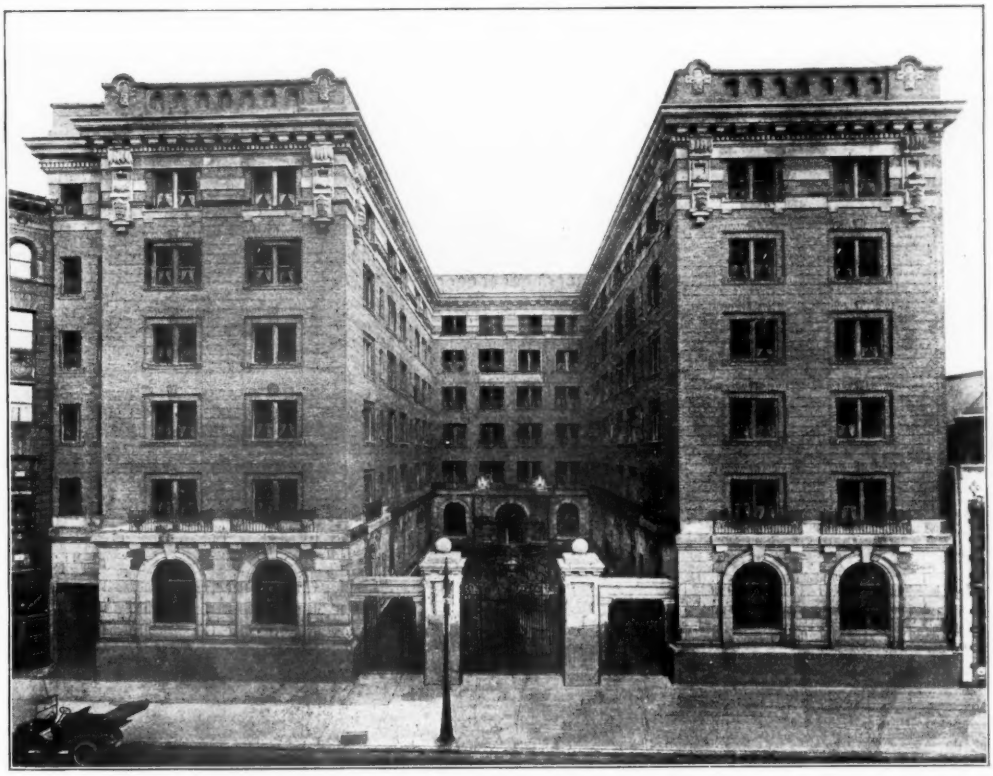
Mercy Hospital has been in existence about sixty years and has accommodations for approximately 500 patients. The Murphy Clinics and the surgical work of Dr. John B. Murphy are the chief attractions of the institution and large numbers of medical men from all over the world attend these clinics. In 1898 a new pavilion was added to Mercy Hospital containing about 200 beds, all for private room patients. The chief features of this new pavilion are its beautiful entrance on Calumet Avenue and the cozy nooks scattered about the corridors in the shape of alcove waiting rooms that are most tastefully furnished with flowers and ferns and bright tapestries. The other features of Mercy are those of any other new, splendidly supported institution.

WESLEY HOSPITAL

Wesley Hospital is directly connected with Northwestern University Medical School and the hospital staff is composed largely of members of the faculty of the school. Wesley has many attractive features, including its milk kitchen, the arrangement of its wards, and its general equipment.

ST. LUKE'S HOSPITAL

St. Luke's, situated at Fifteenth Street and Michigan Boulevard, is one of the show hospitals of the city and one of its best features is the magnificent lobby entering from Michigan Boulevard. There are some splendid features at St. Luke's. Its elevators are housed away in small halls so that the noises do not penetrate the building. These elevators, too, are placed so that they do not attract attention and do not permit of crowds collecting at any one point. All the stairways are enclosed. All the windows are double and of the French casement order. The operating suite is especially well arranged and has unique features of light and ventilation. Mr. Curtis, in building St. Luke's, had in mind the care of his patients as they would be cared for in a splendid hotel and to that end has a cozy guests' dining room in which small parties may dine a la carte—a patient and friends, for instance.



St. Luke's Hospital — 1431 Michigan Avenue.

A great deal of the food preparation is done in an electrically operated service kitchen that is so arranged that neither odors nor noises can penetrate other parts of the house from the kitchen.

GERMAN HOSPITAL

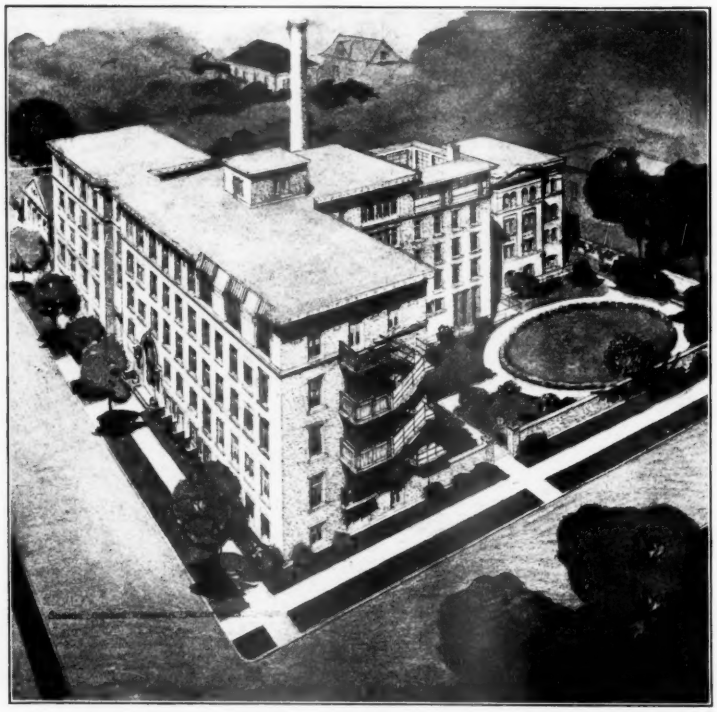
The new German Hospital, of 150 beds, is just recently finished and is a beautiful institution containing many artistic and unique features. Its architecture reminds one of the Italian style and there is an air of luxury and comfort at every turn. Under the capable direction of Miss Nina Dale, its superintendent, there grew up an individuality about the equipment of the German Hospital that lends to it a charm not often seen in institutions of this character. A special feature of this hospital is its operating room light and this alone would be well worth a visit to the North Side.

ALEXIAN BROTHERS' HOSPITAL

This institution, administered by the Alexian Brothers, contains about 200 beds and does not receive women patients. Its largest service is genito-urinary, and its out-patient service is extremely large. For this reason, a unique feature of the institution is the arrangement of a series of dressing rooms that has attracted much attention. Its operating room light is also a unique feature. The building is new, fire-proof, and thoroughly modern in every way.

HENROTIN HOSPITAL

This is a private institution; does not pretend to do any charity work but rather to afford luxurious accommodations to those who can afford to pay. The institution is operated, however, in connection with the Policlinic Hospital, a short distance away, whose service is almost wholly charitable, and both these institutions are conducted as a



The new German Hospital — 6 Grant Place and Hamilton Court.

part of the Chicago Policlinic, a post-graduate medical school. Henrotin has capacity for 85 patients and the Policlinic an equal number.

IROQUOIS MEMORIAL HOSPITAL

The Iroquois Memorial Hospital is situated in the loop district and is intended to take care of emergency work down town. The sentiment of a great number of people centers about this institution because the funds for its creation were supplied as a result of the Iroquois fire.

ST. MARY'S OF NAZARETH HOSPITAL

This institution was founded in 1894. A large part of its building is comparatively new. It is an up-to-date institution, architecturally and from the administrative point of view, and has an excellent medical and surgical staff. The building itself is an imposing structure with an air of solidity and substance.

AUGUSTANA HOSPITAL

Augustana is one of the new hospitals, fireproof, is of modern construction and its equipment is of the most highly approved pattern. The chief feature about Augustana is the clinic of Dr. A. J. Ochsner, whose services to this institution have made it what it is, one of the most substantial hospitals in the West. It is an institution of individuality and bears throughout its administrative function the stamp of Dr. Ochsner's own professional ideals. The institution is under the direction of the Evangelical Lutheran Church and its superintendent, Dr. Wahlstrom, is a clergyman of that denomination. Part of the Augustana was completed in 1893, but the new part of the hospital was opened to the public in 1904. It has three modern operating rooms and its kitchens are on the top floor, a plan of architecture about which much has been said for and against. Fortunately, Augustana realized the necessity of separating ward from private room patients, hence its fourth and fifth floors are kept for private patients and the lower floors for ward patients. Perhaps the most distinguishing feature of Augustana, aside from its surgical function, is the fine business judgment

Children's Memorial Hospital — Fullerton Avenue and Orchard Street. Maurice Porter Pavilion at left, Agnes Wilson Pavilion at right.

exercised in its administration and the economy with which its work is accomplished.

CHILDREN'S MEMORIAL HOSPITAL

This is an institution favored of Chicago's most prominent women. It is exclusively for the care of children and contains approximately 100 beds. Most of its service is free and its support is derived from private sources in the shape of annual subscriptions. There are some fine things about the Children's Memorial Hospital. Its Crib Side pavilion is one of these. Though very plain and simple in all of its parts, it is thoroughly well arranged to care for sick children in the most modern, approved medical fashion. Its sun porches are excellent, wide and long, affording an abundance of fresh air. The windows throughout the hospital are of the French casement order. The milk station of the hospital is one of its best features. The technique of the hospital is rigid and scrupulously followed, even to compelling all of the visitors to wear gowns.

POST-GRADUATE HOSPITAL

The Post-Graduate Hospital, conducted as a part of the Chicago Post-Graduate Medical School, contains approximately one hundred beds and the hospital is made up of faculty members of the school. It has a large out-patient tuberculosis clinic as well as an out-patient department in all branches of medicine. It has an excellent maternity service and its asepsis and the technique for the care of patients are excellently carried out.

OAK FOREST INFIRMARY

A visit to Oak Forest Infirmary will be well worth while. This institution, located twenty-five miles southwest of Chicago, is a farm of 280 acres with a well-arranged group of buildings housing at the present time approximately 2,500 people, including tuberculosis, chronic diseases of childhood, certain classes of recoverable insanities, and a large number of convalescents. The buildings are all new, laid out on modern lines and there is now under construction an additional hospital, modern in every way, for tuberculous

Augustana Hospital — Lincoln and Cleveland Avenues.

patients, and twelve cottages, also for tuberculous patients.

NEW CITY AND COUNTY INSTITUTIONS

Out at West Fortieth Avenue, on the Northwest Side of the city, is the new Municipal Tuberculosis Institute. This institution is now under construction and will eventually house 900 patients, although the present plans call for the housing of only 650. The structure is far enough advanced to afford an abundant opportunity for visitors to see the best construction of tuberculosis architecture, a special form of architecture that is now coming into constant employment.

In addition to the County Hospital, plans have already been drawn for a new psychopathic hospital to take the place of the old Detention Hospital, the administration of which has been the cause of much dissatisfaction on the part of the medical profession because of the necessity of terminating the stay of patients there at the end of ten days. The new building will be four stories high and approximately one hundred feet square. All the latest methods for the segregation and handling of patients suffering from mental disturbances will be utilized.

Under the direction of Dr. George B. Young, Commissioner of Health for the city, plans have

Presbyterian Hospital — Congress, Wood and Harrison Streets. New private pavilion in foreground.

Wesley Hospital — Dearborn and Twenty-Fifth Streets.

Henrotin Memorial Hospital — LaSalle Avenue and Oak Street.

been drawn for the construction of an infectious disease hospital to house about 600 patients. The architecture of this hospital will permit an extension to house 400 more. This institution will occupy a part of the old Bridewell property on the West Side of the city and is intended to replace the present Infectious Disease Hospital at Thirty-fifth and Lawndale Avenue.

PRELIMINARY CLINICAL PROGRAM

SURGICAL CLINICS

COMMITTEE: A. J. OCHSNER, Chairman, CARL BECK, FREDERIC A. BESLEY, and LAWRENCE RYAN

Monday, November 10th

A. J. OCHSNER — Augustana Hospital — 8 to 1.
JAMES J. McGUINN — Columbus Hospital — 10 to 12.
SYLVAN KUNZ — German Hospital — 10 to 12.
BENJAMIN H. BREAKSTONE — Jefferson Park Hospital — 2 to 4.
A. P. HEINECK — Jefferson Park Hospital — 10 to 12.
GILBERT H. WYNEKOOP — Lake View Hospital — 10 to 12.
BENJAMIN H. BREAKSTONE — Maimonides Hospital — 10 to 12.
E. WYLLYS ANDREWS — Michael Reese Hospital — 9 to 12.
EMANUEL FRIEND — Michael Reese Hospital — 9 to 11.
CARL BECK — North Chicago Hospital — 9 to 11.
EMIL G. BECK — North Chicago Hospital — 9 to 11. Bismuth work only.
S. DAHL — Norwegian Deaconess Hospital — 9 to 11.
M. L. HARRIS — Policlinic Hospital — 11.
NORMAN KERR — Policlinic Hospital — 11.
J. R. PENNINGTON — Policlinic Hospital — 2 to 4.
ARTHUR DEAN BEVAN — Presbyterian Hospital — 11 to 1.
G. N. BUSSEY — Ravenswood Hospital — 10 to 12.
G. W. GREEN — Ravenswood Hospital — 8 to 10.
C. G. BUFORD — St. Joseph's Hospital — 2.
CARL WAGNER — St. Joseph's Hospital — 10 to 12.
W. H. ALLPORT — St. Luke's Hospital — 2.
T. A. DAVIS — West Side Hospital — 1 to 3.
EDWARD M. BROWN — West Side Hospital — 8 to 11.
T. J. CONLEY — West Side Hospital — 10 to 12.
J. V. FOWLER — Willard Hospital — 11 to 12.

Tuesday, November 11th

N. M. PERCY — Augustana Hospital — 8 to 10.
C. G. BUFORD — Children's Memorial Hospital — 2.
JACOB FRANK — Columbus Hospital — 8 to 12.
C. VOLINI — Columbus Extension Hospital — 9 to 12.
LAWRENCE RYAN — Cook County Hospital — 8 to 11.
A. G. ZIMMERMAN — German Hospital — 9 to 12.
PAUL GRONNERUD — German Hospital — 10 to 12.
C. I. WYNEKOOP — Lake View Hospital — 8 to 10.
BENJAMIN H. BREAKSTONE — Maimonides Hospital — 10 to 12.
E. WYLLYS ANDREWS — Mercy Hospital — 8 to 10.
L. A. GREENSFELDER — Michael Reese Hospital — 8 to 10.
L. L. McARTHUR — Michael Reese Hospital — 9 to 11.
D. N. EISENDRATH — Michael Reese Hospital — 9 to 12.
EMANUEL FRIEND — Michael Reese Hospital — 9 to 12.
CARL BECK — North Chicago Hospital — 9 to 11.
EMIL G. BECK — North Chicago Hospital — 9 to 11. Bismuth work only.
WM. R. CUBBINS — Post-Graduate Hospital — 2 to 6.
DEAN D. LEWIS — Presbyterian Hospital — 9 to 11.
GEORGE DE TARNOWSKY — Ravenswood Hospital — 8 to 10.
CHARLES H. PARKES — Sheridan Park Hospital — 8.
C. H. McKENNA — St. Joseph's Hospital — 9 to 11.
C. M. McKENNA — St. Joseph's Hospital — 9 to 11.
A. E. HALSTEAD — St. Luke's Hospital — 8 to 11.
AXEL WERELIUS — South Shore Hospital — 9 to 12.
W. E. SCHROEDER — Wesley Hospital — 8 to 10.
F. A. BESLEY — Wesley Hospital — 10 to 12.
E. E. HENDERSON — Frances Willard Hospital — 11 to 1.

Wednesday, November 12th

A. G. ZIMMERMAN — Alexian Brothers Hospital — 9 to 11.
A. J. OCHSNER — Augustana Hospital — 8 to 1.
WM. FULLER — College of P. and S.— 1 to 3.
WM. M. HARSHA — College of P. and S.— 1 to 3.
CARL BECK —Cook County Hospital — 1 to 4.
SYLVAN KUNZ — German Hospital — 10 to 12.
B. A. McBURNEY — Hahnemann Hospital — 10:30.
J. V. FOWLER — House of Correction — 9 to 11.
E. E. TORELL — Lake View Hospital — 9 to 10.
GILBERT H. WYNEKOOP — Lake View Hospital — 10 to 12.
BENJAMIN H. BREAKSTONE — Maimonides Hospital — 10 to 12.
J. B. MURPHY — Mercy Hospital — 8:30 to 12.
E. WYLLYS ANDREWS — Michael Reese Hospital — 9 to 12.
EMANUEL FRIEND — Michael Reese Hospital — 9 to 11.
CARL BECK — North Chicago Hospital — 9 to 11.
J. R. PENNINGTON — Policlinic Hospital — 2 to 5.
WALLACE GROSVENOR — Ravenswood Hospital — 8 to 10.
A. G. SCHROEDER — Ravenswood Hospital — 10 to 12.
LAWRENCE RYAN — St. Anthony's Hospital — 10 to 12.
CARL WAGNER — St. Joseph's Hospital — 10 to 12.
A. E. HALSTEAD — St. Luke's Hospital — 8 to 11.
CHARLES DAVISON — University Hospital — 1 to 3.
A. P. HEINECK — West Side Hospital — 8 to 10.

Thursday, November 13th

N. M. PERCY — Augustana Hospital — 8 to 10.
A. J. OCHSNER — College of P. and S. — 1 to 3.
N. M. PERCY — College of P. and S.— 1 to 3.
JACOB FRANK — Columbus Hospital — 8 to 12.
JAMES J. McGUINN — Columbus Hospital — 10 to 12.
C. VOLINI — Columbus Extension Hospital — 9 to 12.
LAWRENCE RYAN — Cook County Hospital — 8 to 11.
E. WYLLYS ANDREWS — Cook County Hospital — 9 to 2.
A. P. HEINECK — Cook County Hospital — 1 to 3.
ALLAN D. STEWART — Frances Willard Hospital — 3 to 5.
A. G. ZIMMERMAN — German Hospital — 9 to 12.

PAUL GRONNERUD — German Hospital — 10 to 12.
H. R. CHISLETT — Hahnemann Hospital — 8:30.
C. E. KAHLKE — Hahnemann Hospital — 8:30.
C. I. WYNEKOOP — Lake View Hospital — 8 to 10.
BENJAMIN H. BREAKSTONE — Maimondies Hospital — 10 to 12.
CARL BECK — North Chicago Hospital — 9 to 11.
EMIL G. BECK — North Chicago Hospital — 9 to 11. Bismuth work only.
WM. F. SCOTT — Oak Park Hospital — 10 to 12.
M. L. HARRIS — Policlinic Hospital — 11.
NORMAN KERR — Policlinic Hospital — 11.
ARTHUR DEAN BEVAN — Presbyterian Hospital — 11 to 1.
CARL B. DAVIS — Presbyterian Hospital — 11 to 1.
C. N. BUSWELL — Ravenswood Hospital — 8 to 10.
C. H. McKENNA — St. Joseph's Hospital — 10 to 12.
C. G. BUFORD — St. Joseph's Hospital — 2.
A. E. HALSTEAD — St. Luke's Hospital — 8 to 11.
W. H. ALLPORT — St. Luke's Hospital — 2.
AXEL WERELIUS — South Shore Hospital — 9 to 12.
D. A. K. STEELE — University Hospital — 1 to 3.
F. A. BESLEY — Wesley Hospital — 4 to 6.
PAUL B. MAGNUSON — Wesley Hospital — 9 to 12.
H. M. RICHTER — Wesley Hospital — 4 to 6.
C. C. ROGERS — Willard Hospital — 10 to 12.

Friday, November 14th

A. G. ZIMMERMAN — Alexian Brothers Hospital — 9 to 11.
A. J. OCHSNER — Augustana Hospital — 8 to 1.
EDWARD M. BROWN — College of P. & S.— 1 to 3.
F. A. BESLEY — Cook County Hospital — 10 to 12.
A. E. HALSTEAD — Cook County Hospital — 10 to 12.
GEORGE F. THOMPSON — Cook County Hospital — 8 to 10.
SYLVAN KUNZ — German Hospital — 10 to 12.
GILBERT H. WYNEKOOP — Lake View Hospital — 10 to 12.
BENJAMIN H. BREAKSTONE — Maimonides Hospital — 10 to 12.
E. WYLLYS ANDREWS — Mercy Hospital — 8 to 10.
L. A. GREENSFELDER — Michael Reese Hospital — 8 to 10.
L. L. McARTHUR — Michael Reese Hospital — 9 to 11.
D. N. EISENDRATH — Michael Reese Hospital —9 to 12.
EMANUEL FRIEND — Michael Reese Hospital — 9 to 12.
CARL BECK — North Chicago Hospital — 9 to 11.
J. R. PENNINGTON — Policlinic Hospital — 2 to 4.
CHARLES J. ROWAN — Presbyterian Hospital — 11 to 1.
G. N. BUSSEY — Ravenswood Hospital — 10 to 12.
G. W. GREEN — Ravenswood Hospital — 8 to 10.
CARL WAGNER — St. Joseph's Hospital — 10 to 12.
M. J. SEIFERT — St. Mary's of Nazareth Hospital — 8 to 10.
W. E. SCHROEDER — Wesley Hospital — 8 to 10.
ALLEN B. KANAVEL — Wesley Hospital — 4 to 6.
PAUL B. MAGNUSON — Wesley Hospital — 9 to 12.
T. J. CONLEY — West Side Hospital — 10 to 12.

Saturday, November 15th

N. M. PERCY — Augustana Hospital — 8 to 10.
F. G. DYAS — College of P. and S.— 1 to 3.
JACOB FRANK — Columbus Hospital — 8 to 12.
C. VOLINI — Columbus Extension Hospital — 9 to 12.
E. WYLLYS ANDREWS — Cook County Hospital — 9 to 12.
C. E. HUMISTON — Cook County Hospital — 10 to 12.
PAUL F. MORF — Cook County Hospital — 1 to 4.
A. G. ZIMMERMAN — German Hospital — 9 to 12.
H. R. CHISLETT — Hahnemann Hospital — 8:30.
C. E. KAHLKE — Hahnemann Hospital — 8:30.
C. I. WYNEKOOP — Lake View Hospital — 8 to 10.
BENJAMIN H. BREAKSTONE — Maimonides Hospital — 10 to 12.
J. B. MURPHY — Mercy Hospital — 8:30 to 12.
CARL BECK — North Chicago Hospital — 9 to 11.
EMIL G. BECK — North Chicago Hospital — 9 to 11. Bismuth work only.
S. DAHL — Norwegian Deaconess Hospital — 9 to 11.
PAUL GRONNERUD — Policlinic Hospital — 2 to 4.
D. W. GRAHAM — Presbyterian Hospital — 2 to 5.
W. H. ALLPORT — St. Luke's Hospital — 2.
AXEL WERELIUS — South Shore Hospital — 9 to 12.
W. E. SCHROEDER — Wesley Hospital — 10 to 12.

Days and Hours to be Announced

JAMES BURRY — Illinois Steel Co. Hospital.
WILLIAM HESSERT — Alexian Brothers Hospital.
ARTHUR B. EUSTACE — Post-Graduate Hospital.
S. C. PLUMMER — St. Luke's Hospital.

GYNECOLOGICAL AND OBSTETRICAL CLINICS

COMMITTEE: J. CLARENCE WEBSTER, Chairman, FRANK T. ANDREWS, CHARLES S. BACON, and THOMAS J. WATKINS

Monday, November 10th

CHANNING W. BARRETT — Cook County Hospital — 8 to 10.
CAREY CULBERTSON — Cook County Hospital — 8.
ALBERT GOLDSPOHN — Evangelical Deaconess Hospital — 9 to 12.
HENRY BANGA — Policlinic Hospital — 10.
THEODORE J. DOEDERLEIN—German Hospital—9.
FRANK T. ANDREWS — Mercy Hospital — 8 to 10.
EMIL RIES — Post-Graduate Hospital — 9.
HENRY SCHMITZ — St. Mary's Hospital — 8 to 10.
WM. B. FEHRING — Rush Medical College — 11.
ARTHUR H. CURTIS — Wesley Hospital — 9.
ROBERT T. GILLMORE — Wesley Hospital — 10.
MARK T. GOLDSTINE — Wesley Hospital — 10:30.

Tuesday, November 11th

JOHN W. BIRK — Lake View Hospital — 2to 4.
CHANNING W. BARRETT — Policlinic Hospital — 10 to 11.
A. B. KEYES — Policlinic Hospital — 3 to 4.
CAREY CULBERTSON — Rush Medical College — 11.
W. M. THOMPSON — St. Joseph's Hospital — 9.
PHILIP S. DOANE — St. Joseph's Hospital — 2:30.
W. S. BARNES — Wesley Hospital — 3.

Wednesday, November 12th

CHANNING W. BARRETT — Cook County Hospital — 8 to 12.
HENRY F. LEWIS — Cook County Hospital — 3:30.
HENRY SCHMITZ—Frances Willard Hospital—9 to 11.
LESTER FRANKENTHAL—Michael Reese Hospital—9.
FRANK W. LYNCH — Presbyterian Hospital — 11 to 1.
J. CLARENCE WEBSTER—Presbyterian Hospital—11.
N. SPROAT HEANEY — Rush Medical College — 11.
E. C. DUDLEY — St. Luke's Hospital — 2.
MARY G. McEWEN — University Hospital — 9to 11.
ARTHUR H. CURTIS — Wesley Hospital — 9.
MARK T. GOLDSTINE — Wesley Hospital — 10:30.

Thursday, November 13th

CAREY CULBERTSON — Cook County Hospital — 8.
A. B. KEYES — Cook County Hospital — 3 to 4.
ALBERT GOLDSPOHN — Evangelical Deaconess Hospital — 9 to 12.
CHANNING W. BARRETT — Henrotin Hospital — 8 to 10.
JOHN W. BIRK — Lake View Hospital — 2 to 4.
FRANK T. ANDREWS — Mercy Hospital — 8 to 10.
C. v. BACHELLE — Policlinic Hospital — Afternoon.
HENRY BANGA — Policlinic Hospital — 10.
WM. B. FEHRING — Rush Medical College — 11.
PHILIP S. DOANE — St. Joseph's Hospital — 2:30.
W. S. BARNES — Mercy Hospital — 3.
ROBERT T. GILLMORE — Wesley Hospital — 10.
THOS. J. WATKINS — Wesley Hospital — 9.
CHANNING W. BARRETT — West Side Hospital — 3 to 5.

Friday, November 14th

CHANNING W. BARRETT — Policlinic Hospital — 10 to 11.
A. B. KEYES — Policlinic Hospital — 3 to 4.
CAREY CULBERTSON — Rush Medical College — 11.
W. M. THOMPSON — St. Joseph's Hospital — 9.

Saturday, November 15th

CHANNING W. BARRETT — Cook County Hospital — 8 to 10.
LESTER FRANKENTHAL—Michael Reese Hospital—9.
FRANK W. LYNCH — Presbyterian Hospital — 11 to 1.
J. CLARENCE WEBSTER—Presbyterian Hospital—11.
N. SPROAT HEANEY — Rush Medical College — 11.
THOS. J. WATKINS — Wesley Hospital — 9.

Days and Hours to be Announced

CHARLES S. BACON.
E. S. BAILEY — Hahnemann Hospital.
HENRY T. BYFORD — West Side Hospital.
FRANK CAREY.
PETER S. CLARK.
JOSEPH B. DeLEE—Mercy Hospital, Wesley Hospital.
W. A. NEWMAN DORLAND.
DAVIS S. HILLIS — Provident Hospital.
J. C. HOAG — St. Luke's Hospital.
RUDOLPH W. HOLMES — Augustana Hospital.
GUSTAV KOLISCHER.
FRANKLIN H. MARTIN.
B. A. McBURNEY.
CHARLES E. PADDOCK — St. Luke's Hospital.
CHARLES B. REED — Wesley Hospital.
ERNEST SAURENHAUS — West Side Hospital.
GEORGE SCHMAUCH.
L. S. SIMON — Michael Reese Hospital.
HERBERT MARION STOWE.
BERTHA VAN HOOSEN — West Side Hospital.

GENITO-URINARY SURGICAL CLINICS

COMMITTEE: LOUIS E. SCHMIDT, Chairman, WM. T. BELFIELD, ROBERT H. HERBST, GUSTAV KOLISCHER, VICTOR D. LESPINASSE

Monday, November 10th

GUSTAV KOLISCHER — Michael Reese Hospital — 9 to 11.
L. W. BREMERMAN.

Tuesday, November 11th

HERMAN L. KRETSCHMER — Alexian Brothers Hospital — 8 to 10.
B. C. CORBUS — College of P. and S. — 8 to 10.
HARRY A. KRAUS — German Hospital — 4 to 5.
L. W. BREMERMAN — Lakeside Hospital — 8
ROBERT H. HERBST — Policlinic Hospital — 4 to 6.

Wednesday, November 12th

L. E. SCHMIDT — Alexian Brothers Hospital — 9 to 11.
F. KREISSL — Jefferson Park Hospital — 2 to 3.
GUSTAV KOLISCHER — Michael Reese Hospital — 9 to 11.
L. W. BREMERMAN.

Thursday, November 13th

L. W. BREMERMAN — Lakeside Hospital — 8.
ROBERT H. HERBST — Policlinic Hospital — 4 to 6.
J. S. NAGEL — West Side Hospital — 3 to 5.

Friday, November 14th

HERMAN L. KRETSCHMER — Alexian Brothers Hospital — 8 to 10.
D. N. EISENDRATH AND FRENCH S. CARY — College of P. & S. — 2 to 4.
HARRY A. KRAUS — German Hospital — 4 to 5.
F. KREISSL — Jefferson Park Hospital — 2 to 4.
LOUIS E. SCHMIDT—Michael Reese Hospital—9 to 11.
B. C. CORBUS — Post-Graduate Hospital — 3 to 6.
WM. T. BELFIELD — Presbyterian Hospital — 4.
L. W. BREMERMAN.

Saturday, November 15th

L. W. BREMERMAN — Lakeside Hospital — 8.
V. D. LESPINASSE — Wesley Hospital — 3:30.

ORTHOPEDIC CLINICS

COMMITTEE: E. W. RYERSON, Chairman, WALLACE BLANCHARD, CHARLES M. JACOBS, JOHN L. PORTER and HENRY B. THOMAS

Monday, November 10th

E. W. RYERSON — Children's Memorial Hospital — 3 to 6; Policlinic Hospital — 1 to 2.
THOMAS P. LYNAM — Home for Destitute Crippled Children — 2 to 4.

Tuesday, November 11th

JOHN L. PORTER — College of P. and S.— 9 to 11; Home for Destitute Crippled Children — 11 to 1.
WALLACE BLANCHARD — Home for Destitute Crippled Children — 2 to 4.

Wednesday, November 12th

E. W. RYERSON — Children's Memorial Hospital — 3 to 6; Policlinic Hospital — 1 to 2.
P. B. MAGNUSON — Home for Destitute Crippled Children—2 to 4.

Thursday, November 13th

HENRY B. THOMAS — Cook County Hospital — 11 to 12.
E. W. RYERSON — Home for Destitute Crippled Children — 2 to 4.

Friday, November 14th

WALLACE BLANCHARD — Home for Destitute Crippled Children — 2 to 4.
E. W. RYERSON — Policlinic Hospital — 1 to 3.

Saturday, November 15th

C. M. JACOBS — Home for Destitute Crippled Children — 2 to 4.

OPHTHALMOLOGICAL CLINICS

COMMITTEE: WM. H. WILDER, Chairman, EDWARD V. L. BROWN and CASSIUS D. WESTCOTT

Monday, November 10th

WILLIS O. NANCE — Illinois Charitable Eye & Ear Infirmary — 2:30.
G. W. MAHONEY — Policlinic Hospital — 9.
W. FRANK COLEMAN — Post-Graduate Hospital — 4.
WILLIAM H. WILDER — Rush Medical College — 2:30.

Tuesday, November 11th

CHARLES H. BEARD — Illinois Charitable Eye & Ear Infirmary — 2:30.
ALFRED N. MURRAY — Lake View Hospital — 1 to 3.
CHARLES H. FRANCIS — Policlinic Hospital — 9.
GEORGE F. SUKER — Post-Graduate Hospital — 9.

Wednesday, November 12th

OLIVER TYDINGS — Chicago Eye, Ear, Nose & Throat Hospital — 2 to 3.
J. B. LORING — College of P. and S.— 3.
OSCAR DODD — Illinois Charitable Eye & Ear Infirmary — 2:30.
S. MEAD HAGER — Policlinic Hospital — 9.
W. FRANK COLEMAN — Post-Graduate Hospital — 9.
GEORGE F. SUKER — Post-Graduate Hospital — 2.

Thursday, November 13th

WM. H. WILDER — Illinois Charitable Eye & Ear Hospital — 2:30.
G. W. MAHONEY — Policlinic Hospital — 9.

Friday, November 14th

H. W. WOODRUFF — Illinois Charitable Eye & Ear Hospital — 2:30.
ALFRED N. MURRAY — Lake View Hospital — 1 to 3.
CHARLES H. FRANCIS — Policlinic Hospital — 9.
W. FRANK COLEMAN — Post-Graduate Hospital — 4.

Saturday, November 15th

OLIVER TYDINGS — Chicago, Eye, Ear, Nose & Throat Hospital — 2 to 3.
E. V. L. BROWN — Illinois Charitable Eye & Ear Hospital — 2:30.
S. MEAD HAGER — Policlinic Hospital — 9.
GEORGE F. SUKER — Post-Graduate Hospital — 2.

Days and Hours to be Announced Later

C. GURNEE FELLOWS — Hahnemann Hospital.
RICHARD J. TIVNEN — Mercy Hospital.
MORTIMER FRANK — Michael Reese Hospital.
E. F. SNYDACKER — Michael Reese Hospital.
BROWN PUSEY — Northwestern University and Wesley Hospital.
CASEY A. WOOD — St. Luke's Hospital.
FRANK ALLPORT — St. Luke's Hospital.
CASSIUS D. WESCOTT — St. Luke's Hospital.
WM. E. GAMBLE — University Hospital.

LARYNGOLOGICAL AND RHINOLOGICAL CLINICS

COMMITTEE: FREDERICK MENGE, Chairman, WM. I. BALLENGER, and JOHN EDWIN RHODES

Monday, November 10th

OLIVER TYDINGS — Chicago Eye, Ear, Nose & Throat Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
STANTON A. FRIEDBERG — Cook County Hospital — 2 to 4.
NOAH SCHOOLMAN — Maimonides Hospital — 10 to 12.
CHARLES M. ROBERTSON — Policlinic Hospital — 2:30 to 5.
P. J. H. FARRELL — St. Joseph's Hospital — 3 to 5.
T. MELVILLE HARDIE — St. Luke's Hospital.

Tuesday, November 11th

G. W. BOOT — Central Free Dispensary — 2.
JOSEPH C. BECK — Cook County Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
OTTO T. FREER — Policlinic Hospital — 4 to 5.
CHARLES H. LONG — Post-Graduate Hospital — 8:30 to 12.
P. J. H. FARRELL — Sheridan Park Hospital — 4 to 5.
AUSTIN A. HAYDEN — St. Joseph's Hospital — 9 to 12.

Wednesday, November 12th

D. B. HAYDEN — Central Free Dispensary — 2 to 4.
G. W. BOOT — Cook County Hospital — 1.
BURTON HASELTINE — Hahnemann Hospital — afternoon.
JOHN EDWIN RHODES — Home for Destitute Crippled Children — 8. Rush Medical College — 2 to 4.
OTTO T. FREER — Maimonides Hospital — 2 to 4.
OTTO J. STEIN — Post-Graduate Hospital — 2 to 5.
AUSTIN A. HAYDEN — St. Bernard's Hospital — 10 to 12.
FREDERICK MENGE — Wesley Hospital — 8 to 12.
R. H. GOOD — Frances Willard Hospital — 3.

Thursday, November 13th

OLIVER TYDINGS — Chicago Eye, Ear, Nose & Throat Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
JOSEPH C. BECK — Cook County Hospital — 3 to 6.
RICHARD H. BROWN — College of P. and S. — 9 to 11.
AUSTIN A. HAYDEN — People's Hospital — 2 to 4.
CHARLES M. ROBERTSON — Policlinic Hospital — 2:30 to 5.
CHARLES H. LONG — Post-Graduate Hospital — 8:30 to 12.
P. J. H. FARRELL — St. Joseph Hospital — 3 to 5.

Friday, November 14th

G. W. BOOT — Central Free Dispensary — 2.
D. B. HAYDEN — Central Free Dispensary — 2 to 4.
WM. L. BALLENGER — College of P. and S. — 10 to 12.
G. W. BOOT — Cook County Hospital — 1.
STANTON A. FRIEDBERG — Cook County Hospital — 2 to 4.
OTTO T. FREER — Policlinic Hospital — 4 to 5.
GEORGE E. SHAMBAUGH — Rush Medical College, Senn Hall — 2 to 4.
P. J. H. FARRELL — Sheridan Park Hospital — 2 to 4.
AUSTIN A. HAYDEN — St. Joseph's Hospital — 9 to 12.

Saturday, November 15th

GEORGE W. BOOT — Children's Memorial Hospital — 5:30.
JOSEPH C. BECK — Cook County Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
NOAH SCHOOLMAN — Maimonides Hospital — 10 to 12.
CHARLES H LONG — Post-Graduate Hospital — 8:30 to 12.
ARTHUR M. CORWIN — West Side Hospital — 8:30.

Days and Hours to be Announced Later

FRANK E. BRAWLEY — St. Luke's Hospital.
J. T. CAMPBELL — Post-Graduate Hospital.
G. J. DENNIS — Wesley Hospital.
MORTIMER FRANK — Michael Reese Hospital.
J. HOLINGER — St. Elizabeth's Hospital.
E. F. INGALS.
HARRY KAHN — Michael Reese Hospital.
O. H. MACLAY — Wesley Hospital.
GEORGE P. MARQUIS — St. Luke's Hospital.
ROBERT SONNENSCHEIN — Rush Medical College.
C. B. YOUNGER — Wesley Hospital.

ORAL SURGICAL CLINICS

COMMITTEE: TRUMAN W. BROPHY, Chairman, THOMAS L. GILMER, and WM. H. G. LOGAN

Days and Hours to be Announced Later

THOMAS L. GILMER — St. Luke's Hospital and Northwestern University Dental School.
ARTHUR D. BLACK — St. Luke's Hospital and Northwestern University Dental School.
WM. H. G. LOGAN — Frances Willard Hospital.
TRUMAN W. BROPHY — Presbyterian Hospital and Frances Willard Hospital.
HERBERT A. POTTS — Northwestern University Dental School.
FREDERICK B. MOOREHEAD — Presbyterian Hospital.

OTOLOGICAL CLINICS

COMMITTEE: NORVAL H. PIERCE, Chairman, J. HOLINGER and GEORGE E. SHAMBAUGH

Monday, November 10th

OLIVER TYDINGS — Chicago Eye, Ear, Nose & Throat Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
IRA FRANK — Michael Reese Hospital — 9.
JOSEPH BECK — North Chicago Hospital — 3 to 6.
J. GORDON WILSON — Northwestern University Medical School — 10.
J. HOLINGER — St. Joseph's Hospital — 9.
T. MELVILLE HARDIE — St. Luke's Hospital.

Tuesday, November 11th

G. W. BOOT — Central Free Dispensary — 2.
G. W. BOOT — Cook County Hospital — 1.
JOSEPH BECK — County Hospital — 3 to 6.
H. H. BOETTCHER — Illinois Eye and Ear Infirmary—2.
DAVID FISKE — Policlinic — 2:30.
FRANK ALLPORT — St. Luke's Hospital — 2. General eye, ear, nose and throat clinic.

Wednesday, November 12th

J. HOLINGER — Alexian Brothers Hospital — 9.
JOHN A. CAVANAUGH — Chicago Eye, Ear, Nose and Throat Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
NORVAL H. PIERCE — Illinois Eye and Ear Infirmary—2.
JOSEPH BECK — North Chicago Hospital — 3 to 6.
O. J. STEIN — Post Graduate Medical School — afternoon.
FRANK ALLPORT — St. Luke's Hospital — 2. General eye, ear, nose and throat clinic.

Thursday, November 13th

OLIVER TYDINGS — Chicago Eye, Ear, Nose & Throat Hospital — 3 to 6.
DAVID FISKE — Children's Memorial Hospital — 1 to 3.
JOSEPH BECK — Cook County Hospital — 3 to 6.
G. W. BOOT — Cook County Hospital — 1.
ALFRED LEWY — Hahnemann Hospital — 2:30.
CHARLES M. ROBERTSON — Policlinic — 2:30.
IRA FRANK — Michael Reese Hospital — 9.
J. HOLINGER — St. Joseph's Hospital — 9.
A. H. ANDREWS — Wesley Hospital — morning.

Friday, November 14th

G. W. BOOT — Central Free Dispensary — 2.
W. A. BALLENGER — College of P. & S. — 10 to 12.
G. W. BOOT — Cook County Hospital — 1.
H. H. BOETTCHER — Illinois Eye and Ear Infirmary — 2.
JOSEPH BECK — North Chicago Hospital — 3 to 6.
DAVID FISKE — Policlinic — 2:30.
GEORGE E. SHAMBAUGH — Rush Medical College, Senn Hall — 2 to 4.
FRANK ALLPORT — St. Luke's Hospital — 2. General eye, ear, nose and throat clinic.

Saturday, November 15th

J. HOLINGER — Alexian Brothers Hospital — 9.
JOSEPH BECK — Chicago Eye, Ear, Nose and Throat Hospital — 3 to 6.
JOHN A. CAVANAUGH — Chicago Eye, Ear, Nose and Throat Hospital — 3 to 6.
GEORGE W. BOOT — Children's Memorial Hospital — 5:30.
G. W. BOOT — Cook County Hospital — 1.
NORVAL H. PIERCE — Illinois Eye and Ear Infirmary — 2.
J. GORDON WILSON — Northwestern University Medical School — 10.

President American Gynecological Society